SIMPLE

ELEMENTS OF NAVIGATION.

BY

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PREFACE.

THIS little work is not intended to supply any presumed deficiency in other books treating of the same subject, but to preserve one common method throughout and to omit all complicated mathematical formulæ and calculations beyond the reach of men of limited education.

The most simple elements of navigation only are treated of, and the tables added to make the little work complete in everything necessary to navigate a vessel to any port of the globe.

By a study of no other instructions than those contained in this little treatise, the nautical apprentice can soon fit himself for promotion; the merchantman make himself competent to conduct his vessel to his destination; and the owner of a yacht, with a little trouble, become able to co-operate with his captain. Other works are intended for the use of accomplished mathematicians or experienced navigators.

PREFACE TO SECOND EDITION.

THE success which has greeted the first edition has led the author to make certain additions to the Second Edition which will serve to increase its usefulness.

A chapter on "Compass Adjustment" and one on "General Examples for Exercise" will be found in this edition, as well as an article giving short instructions for the "Relief of the Sick and the Wounded." Some typographical errors have been corrected, and it is hoped a new value has been given to the work.

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SIMPLE ELEMENTS OF NAVIGATION.

CHAPTER I.

Description and Use of Instruments.

Definitions. Navigation is the science which treats of the determination of a ship's position at sea and the particular direction a vessel should steer to reach any given place. It may be said to consist of two kinds:

Firstly, the science of navigation by which the position of the ship is determined from day to day by referring it to some other geographical spot, such as a known landmark, a determinate bottom, or a previously defined place.

Secondly, the science by which the position of the ship is determined from observations of the heavenly bodies.

The voluminous works on this subject are full of difficult and complicated calculations, which only an expert mathematician can understand. They are beyond reach of the class of young men of limited education, who enter an apprenticeship either in the merchant marine or the naval service. Moreover, these works are filled with many methods by which the same problem is solved, embarrassing to the beginner instead of instructing him.

In order to simplify this as much as possible it is proposed to imagine a vessel in port with everything stowed ready for sea, and to confine the problems to the most common methods in her voyage to some other port across the ocean.

Use of Instruments. The first thing to do on going on board is to become acquainted with the use and application of such instruments as are necessary to determine the distance which the ship sails, the direction in which she is steered, and

to deduce, from the data these instruments furnish, the situation of the ship at any time, and to find the distance and direction of any place to which it may be required that the ship should be taken.

Hand-lead is used to obtain soundings in shallow water, with a view of safely guiding the ship over shoals, through channels to an anchorage, or to sea; it is in weight ranging from five to fourteen pounds.

Deep-sea Lead is used to obtain soundings in deeper water and to ascertain the nature of the bottom; it is in weight ranging from twenty-five to one hundred pounds; is hollow at the bottom, for placing a lump of tallow called the **Arming.** The nature of the bottom is indicated by the portion of the bottom brought up in the arming.

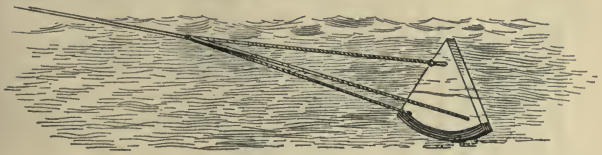
In heaving this lead the headway of the ship must be checked to get a cast; to obviate this many ingenious instruments have been invented by which the soundings can be taken from a ship running at full speed, in water of any depth not exceeding one hundred and fifty fathoms (a fathom is six feet). Some of these instruments register the depth of water descended through by wheel-work set in motion by a fly, and others by the condensation of air contained in a glass tube by the pressure of water; but the most common one in use is the Thomson sounding-machine, which has a glass tube connected with a sinker, closed at the top and coated inside with chromate of silver; the increased pressure at greater depths drives the water up the tube, and its action leaves a white mark, the position of which is estimated by a scale, and it is independent of the amount of line run out. A small steel wire is used instead of a line, and is coiled on a light reel.

Log and Glass are used to measure the rate of sailing, and a timepiece to note the interval. The log consists of several parts—chip, bridle, line, and reel.

Log-chip is a thin piece of wood, in the form of a sector of about five inches radius, weighted on the circular edge with lead sufficient to make it swim upright in the water.

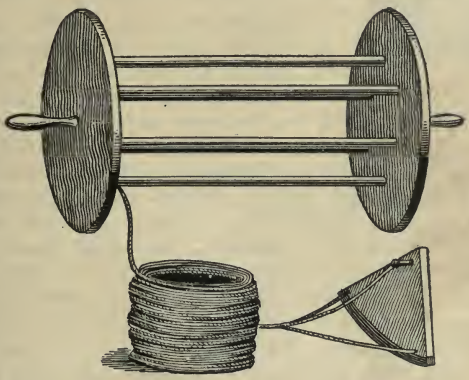
At each of the three corners is a hole, through two of which legs of the bridle are rove and knotted; the third leg has a peg of wood in the end, which, when the log is hove, is firmly pressed into the unoccupied hole: it remains thus while the line is running out, and pulls away when the line is being

hauled in. The legs of the bridle are about two feet long, and bent to the outer end of the log-line.



LOG-CHIP.

Log-line is a small line of about 150 fathoms long, one end attached to the bridle and the other fastened to a "**reel,**" over which the log-line is wound. At about 15 fathoms from



LOG-REEL.

the chip a white rag is placed to mark what is called the "**stray-line,**" which permits the chip to clear the wake of the ship or swash of the propeller. From this rag inboard the line is divided into equal portions by bits of small line through the strands of the log-line, and designated by the number of knots in each; hence are called knots. The length of each of these divisions of the line bears the same ratio to the nautical mile that the glass does to an hour. The division of the line between the knots is divided into tenths, marked by a small string.

Log-glass is an ordinary sand-glass constructed so as to permit the sand to run from one end to the other in a certain time: those in common use are the long-glass, which requires 28 seconds, and the short-glass, 14 seconds, to run through. The line is graduated for the long-glass, and when the short-glass is used the knots indicated should be doubled.

LOG-GLASS.

Heaving the Log. The using of these is called heaving the log. One man holds the reel in a horizontal position and another holds the glass with the sand down, while a third takes the log-chip and presses the peg into its place, then unwinds a quantity of line, and holding it faked in his hand, calls "**Clear glass,**" repeated by the man holding the glass. The one with the line throws the chip over the lee quarter to clear the wake, and permits the line to run freely through his hand, feeding and checking if necessary, and when the white rag passes his hand he cries out "**Turn;**" the glass is then turned. The glass-holder answers **Turn,** and holds the glass up so as to permit the sand to run through. The moment the sand is run out the glass-holder calls out "**Up,**" when the line is checked and the knots and tenths indicated. The log is hove every hour, and should be whenever the course is changed.

Log Adjustments. The log requires to be frequently adjusted, when the peg should be examined and found to fit sufficiently tight. The log-line shrinks unequally, and requires to be frequently verified. A convenient method is by having nails placed in the deck at proper distances to measure from, the line being wet at the time. In damp weather the sand in the glass becomes wet, and is not only retarded, but often hangs altogether: when this is the case the cork stopper in the end is removed, the sand taken out and replaced by dry, or the quantity of sand can be reduced or increased in this way when the glass is in error. The glass-error is found by comparison with the second hand of a watch or a small second-pendulum. A pendulum for comparison can easily be constructed

by having hung from a nail a small bullet by a thread $38\frac{1}{8}$ inches long from the centre of the bullet to the nail.

Many and most efficient patent logs have been devised, and have been found very accurate, and have been frequently substituted for the common log; however, one acts as a check on the other, and both should be used. The most common of these is the **Taffrail Log,** which consists of a rotator or fly towed astern clear of the wake by a line, and the register is attached to the taffrail. As the fly is drawn through the water in a horizontal position, the motion is communicated by means of the connecting cord to the wheel-work within the register, and sets in motion the indices. By this means the rate of the ship can be read off at any time by simply going to the rail and noting the interval it takes the dial to make one mile.

Ground-log is a log adapted for use in shoal water to ascertain when in doubt the set of the current; it consists of a small lead and a line divided in the same manner as the common line. When hove, the lead remains on the bottom and the line gives the combined motion of the ship through the water and that of the current.

Compass denotes the direction sailed, and indicates the future course. The compass is simply an instrument which utilizes the directive powers of the magnet.

Card and Needle. The essential part of the mariner's compass consists of a circular card upon which are marked the various points, and is carried by a magnetized needle placed under the line joining the north and south points.

The needle is freely balanced upon a fine pivot rising from the bottom of a brass or copper bowl by means of a small agate cup fixed in the centre of the needle.

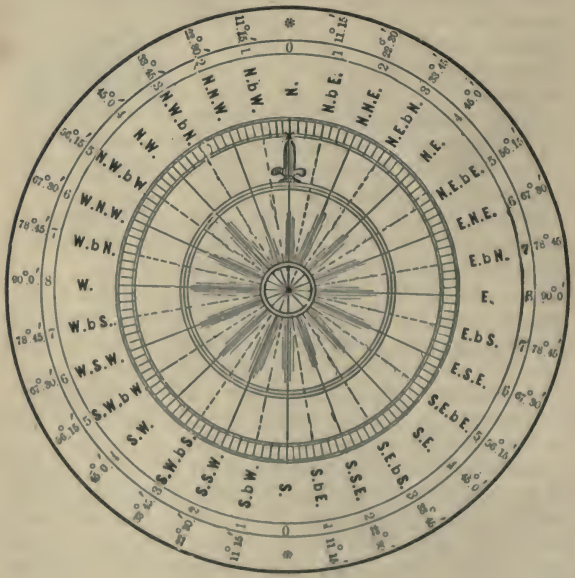
Compass Bowl, containing the needle and card, is carried on gimbals, so that it may at any time remain level in whatever direction the ship may roll or pitch. The bowl has a glass cover, and is fitted to carry lights to illuminate the face of the card at night. This case and stand is called the **Binnacle.**

Lubber's Point. Inside the bowl is painted a black vertical line, commonly called the *lubber's point.* The centre of the compass card and this lubber's point should be in a line with the keel of the vessel, and the point marked on the card

the ship is to be steered should be kept coincident with this point.

Points of the Compass. The compass card is divided into four quadrants by two diameters perpendicular to each other; the ends of these diameters are called *north*, *south*, *east*, and *west*, and are marked N., S., E., W.: they are termed the "**Cardinal points.**" Each of these quadrants is divided into eight equal spaces or points; hence there are thirty-two points to the compass. These thirty-two points are in turn subdivided into half and quarter points.

The following figure will show the names of these points.



MARINER'S COMPASS.

The half and quarter points are indicated from any of the 32 points towards one of the cardinal points, thus: N. ½ E. means half a point from the north towards the east. SW. ½ W. means half a point from the southwest towards the west.

Boxing the Compass. The repetition of the names of these points consecutively is called boxing the compass.

The compass card is also divided into degrees for the convenience of taking bearings, and the following table will give the points, half and quarter points, with the corresponding degrees, from which they can be easily converted one to the other.

TABLE FOR CONVERTING POINTS INTO DEGREES.

N. to E.	N. to W.	S. to E.	S. to W.	Points.	Degrees.
North	North.	South.	South.	0	00°00′00″
N. ¼ E.	N. ¼ W.	S. ¼ E.	S. ¼ W.	0¼	2 48 45
N. ½ E.	N. ½ W.	S. ½ E.	S. ½ W.	0½	5 37 30
N. ¾ E.	N. ¾ W.	S. ¾ E.	S. ¾ W.	0¾	8 26 15
N. by E.	N. by W.	S. by E.	S. by W.	1	11 15 00
N. by E. ¼ E.	N. by W. ¼ W.	S. by E. ¼ E.	S. by W. ¼ W.	1¼	14 03 45
N. by E. ½ E.	N. by W. ½ W.	S. by E. ½ E.	S. by W. ½ W.	1½	16 52 30
N. by E. ¾ E.	N. by W. ¾ W.	S. by E. ¾ E.	S. by W. ¾ W.	1¾	19 41 15
NNE.	NNW.	SSE.	SSW.	2	22 30 00
NNE. ¼ E.	NNW. ¼ W.	SSE. ¼ E.	SSW. ¼ W.	2¼	25 18 45
NNE. ½ E.	NNW. ½ W.	SSE. ½ E.	SSW. ½ W.	2½	28 07 30
NNE. ¾ E.	NNW. ¾ W.	SSE. ¾ E.	SSW. ¾ W.	2¾	30 56 15
NE. by N.	NW. by N.	SE. by S.	SW. by S.	3	33 45 00
NE. ¼ N.	NW. ¼ N.	SE. ¼ S.	SW. ¼ S.	3¼	36 33 45
NE. ½ N.	NW. ½ N.	SE. ½ S.	SW. ½ S.	3½	39 22 30
NE. ¾ N.	NW. ¾ N.	SE. ¾ S.	SW. ¾ S.	3¾	42 11 15
NE.	NW.	SE.	SW.	4	45 00 00
NE. ¼ E.	NW. ¼ W.	SE. ¼ E.	SW. ¼ W.	4¼	47 48 48
NE. ½ E.	NW. ½ W.	SE. ½ E.	SW. ½ W.	4½	50 37 30
NE. ¾ E.	NW. ¾ W.	SE. ¾ E.	SW. ¾ W.	4¾	53 26 15
NE. by E.	NW. by W.	SE. by E.	SW. by W.	5	56 15 00
NE. by E. ¼ E.	NW. by W. ¼ W.	SE. by E. ¼ E.	SW. by W. ¼ W.	5¼	59 03 45
NE. by E. ½ E.	NW. by W. ½ W.	SE. by E. ½ E.	SW. by W. ½ W.	5½	61 52 30
NE. by E. ¾ E.	NW. by W. ¾ W.	SE. by E. ¾ E.	SW. by W. ¾ W.	5¾	64 41 15
ENE.	WNW.	ESE.	WSW.	6	67 30 00
E. by N. ¾ N.	W. by N. ¾ N.	E. by S. ¾ S.	W. by S. ¾ S.	6¼	70 18 45
E. by N. ½ N.	W. by N. ½ N.	E. by S. ½ S.	W. by S. ½ S.	6½	73 07 30
E. by N. ¼ N.	W. by N. ¼ N.	E. by S. ¼ S.	W. by S. ¼ S.	6¾	75 56 15
E. by N.	W. by N.	E. by S.	W. by S.	7	78 45 00
E. ¾ N.	W. ¾ N.	E. ¾ S.	W. ¾ S.	7¼	81 33 45
E. ½ N.	W. ½ N.	E. ½ S.	W. ½ S.	7½	84 22 30
E. ¼ N.	W. ¼ N.	E. ¼ S.	W. ¼ S.	7¾	87 11 15
East.	West.	East.	West.	8	90 00 00

According to the purpose for which the mariner's compass is especially adapted it is named the *steering, standard,* and *azimuth* compass.

Steering Compass is the one placed in the binnacle near the wheel to assist the man at the wheel in keeping the ship's head in the prescribed direction.

Standard Compass is the one placed on a particular spot on deck or above it where the local influence of the iron in the ship is the smallest and to which the steering compass is always referred.

Azimuth Compass is the one mounted on a stand in some commanding position for the purpose of taking bearings, and is provided with a pair of sight vanes for observing objects. The standard compass is usually an azimuth compass.

Variation. The direction the horizontal needle assumes when uninfluenced by external causes is called the magnetic north, and at different times and places does not coincide with the true north. The difference between these two directions measured in degrees is called variation. It is said to be easterly when the north end of the needle is drawn to the eastward, and westerly when it is drawn to the westward, of the true north. The variation is found on the chart.

Deviation is the term applied to indicate the effect produced on the compass by objects within the ship, such as the ship being built of iron, laden with iron or having certain attachments made of iron, and local influences external to the ship. Vertical iron, such as boat-davits, iron stanchions, smokestack, etc., has the greatest effect when the ship's head is north or south and least when east or west; and the horizontal pieces of iron, such as deck beams, engine shafts, etc., will affect the compass most at the four points lying between the cardinal points and least at the north, south, east, and west points.

The introduction of iron in shipbuilding has rendered the question of deviation most important, and the amount will depend upon the direction in which the ship's head lies while building; if built with her head north or south she will receive a large amount of induced magnetism from the hammering necessary and from the earth. This magnetism once driven in, may be increased or diminished by grating against piers, striking sunken rocks, or being struck by a heavy sea.

It has also been found the deviation is different when the vessel heels over on either side, to what it is when she is on an even keel: in northern latitudes the compass needle is drawn to windward as the vessel heels over, and whenever the

vessel head is E. or W. the heeling error vanishes and is greater when it is N. or S.

The deviation changes when the ship proceeds to a different latitude, hence should be frequently ascertained and tables constructed by the process of swinging ship not only on an even keel, but also when the ship is heeled over to starboard and when heeled over to port.

To Find the Deviation. The standard compass is placed in its permanent position, and the ship is taken to some place in smooth water and caused to swing around that her head may be made to come to every point of the compass, and as she does the deviation is ascertained as follows:

I. By means of buoys the true bearings of which have been previously ascertained.

II. When in an open harbor where some fixed object at a distance of eight or ten miles can be clearly seen. Write down the points of the compass, and as the ship swings around from one point to another write down the compass bearing of the object opposite the point of the compass towards which the ship's head is directed. The mean of two bearings on east and west by compass, or the mean of all these bearings, will be the magnetic bearing of the distant object from the ship, the difference of which from each of the bearings will give the deviation for that point of the ship's head. It is thus that the majority of deviation tables are constructed.

III. When the ship is in a closed harbor and no distant object can be seen, a standard compass is taken on shore and placed in such a position as to be free from the influences of magnetic attraction, and where it may be seen. As the ship swings around the bearing of the compass on shore is observed from the ship as her head comes to each point, and at the same instant, indicated by signals, the ship's compass is observed from shore. The observations on shore are first reversed to bring them into the same direction as those taken from the ship, and are compared with the latter; the difference is the deviation. Should there be a suspicion of local attraction to the compass on shore a plane table may be used instead of the shore compass.

IV. When at sea or out of sight of land if a distant sail be in sight, advantage may be taken of a calm or light airs to swing

ship by it as in the second case or by the true bearing of the sun explained in Chapter X.

The deviation for the ship's head at each of the points of the compass having been obtained by any of the processes which have been described, a table of the results should be constructed, marking the deviation east when the north end of the needle has been drawn to the eastward, and west when it has been drawn to the westward, of the magnetic north. These tables should be constructed and made use of even though the compasses be or be not corrected by magnets or masses of iron as is the practice in iron ships.

The following is the form of a deviation table:

DEVIATION TABLE.

Ship's head.	Deviation.	Ship's head.	Deviation.
North.	2 20 E.	South.	2 40 W.
N. by E.	3 40 E.	S. by W.	3 50 W.
NNE.	5 40 E.	SSW.	5 50 W.
NE. by N.	6 50 E.	SW. by S.	6 00 W.
NE.	8 00 E.	SW.	6 50 W.
NE. by E.	8 10 E.	SW. by W.	7 30 W.
ENE.	7 20 E.	WSW.	7 50 W.
E. by N.	7 30 E.	W. by S.	8 10 W.
East.	6 40 E.	West.	8 00 W.
E. by S.	5 50 E.	W. by N.	7 40 W.
ESE.	4 30 E.	WNW.	6 40 W.
SE. by E.	3 40 E.	NW. by W.	5 40 W.
SE.	2 00 E.	NW.	4 30 W.
SE. by S.	1 00 E.	NW. by N.	3 10 W.
SSE.	0 30 W.	NNW.	1 50 W.
S. by E.	1 30 W.	N. by W.	0 30 E.

Leeway is an apparent error to which the compass is subjected, and is due to the pressure of the wind and surge of the sea driving the vessel to leeward, when close hauled, of the direction by compass it is intended she should sail. The amount depends upon the lines and trim of the ship, the draft and sails used, or whether the ship be as near the wind as she will lie. Leeway is estimated in points and quarter points by observing the wake astern. If the wind is on the starboard hand the leeway is to the left, and if on the port hand it is to the right.

Course of a ship and the **bearing** of an object are terms used with reference to the standard compass, to the magnetic meridian, and to the true meridian. The course of the ship by

the standard compass, which is affected by both deviation and variation, is called the "*compass course;*" the course with reference to the magnetic meridian, or the course which would be shown by the compass on board affected by variation only and not by the deviation, is called the "*correct magnetic course.*" The course with reference to the true meridian is called the "*true course.*" In the same way the bearing of an object may be distinguished as the *compass bearing, correct magnetic bearing,* or the *true bearing,* as the case may be.

In any conversion from one compass course to another, or from one compass bearing to another, whether the correction is made by applying the variation or the deviation, both corrections are applied to the right if easterly, and to the left if westerly. Similarly, where the conversion is from one true course to another or from one true bearing to another, both are applied to the right if westerly, and to the left if easterly. The method will appear in the following examples.

A vessel heads by compass NNE. ½ E. The variation shown on the chart is 21° 14′ E.; find the true course.

The compass course NNE. ½ E. or	N. 28° 07′ 30″ E.
Variation E.	21 14 00 right
The magnetic course	N. 49 21 30 E.
From table deviation for NNE. ½ E.	6 15 00 E. or to right.
True course	N. 55 36 30 E.

Again with the head of the vessel at ESE. the variation was shown on the chart to be 10° 15′ W.; find the true course.

From compass table ESE. is . .	S. 67° 30′ 00″ E.
Variation from chart W. . . .	10 15 00 left.
True magnetic course	S. 77 45 00 E.
Deviation for ESE. from table E.	4 30 00 right.
True course	S. 73 15 00 E.

The variation being given by the chart may be considered as a constant quantity, but not so with the deviation, which may vary for every point of the ship's head. The frequent use of the deviation table might result in mistakes, to avoid which, it will be better to construct another table for the convenience of the compass course or bearing to convert to the magnetic course or bearing and *vice versa.* The compass

course or ship's head is written in the first column, the deviation in the second as found from the observations already described, and the magnetic course in the third column, thus:

Ship's head.	Deviation.	Magnetic Course	Ship's head.	Deviation.	Magnetic Course.
	° ′	° ′		° ′	° ′
North.	2 20 E.	N. 2 20 E.	South.	2 40 W.	S. 2 40 E.
N. by E.	3 40 E.	N. 14 15 E.	S. by W.	3 50 W.	S. 7 25 W.
NNE.	5 40 E.	N. 28 10 E.	SSW.	5 20 W.	S. 17 10 W.
NE. by N.	6 50 E.	N. 40 35 E.	SW. by S.	6 00 W.	S. 27 45 W.
NE.	8 00 E.	N. 53 00 E.	SW.	6 30 W.	S. 38 30 W.
NE. by E.	8 10 E.	N. 64 25 E.	SW. by W.	7 30 W.	S. 48 45 W.
ENE.	7 20 E.	N. 74 50 E.	WSW.	7 50 W.	S. 59 40 W.
E. by N.	7 30 E.	N. 86 15 E.	W. by S.	8 10 W.	S. 70 35 W.
East.	6 40 E.	S. 83 20 E.	West.	8 00 W.	S. 82 00 W.
E. by S.	5 50 E.	S. 72 55 E.	W. by N.	7 40 W.	N. 86 25 W.
ESE.	4 30 E.	S. 63 00 E.	WNW.	6 40 W.	N. 74 10 W.
SE. by E.	3 40 E.	S. 52 35 E.	NW. by W.	5 40 W.	N. 61 55 W.
SE.	2 00 E.	S. 43 00 E.	NW.	4 30 W.	N. 49 30 W.
SE. by S	1 00 E.	S. 32 45 E.	NW. by N.	3 10 W.	N. 36 55 W.
SSE.	0 30 W.	S. 23 00 E.	NNW.	1 50 W.	N. 24 20 W.
S. by E.	1 30 W.	S. 12 45 E.	N. by W.	0 30 E.	N. 10 45 W.

To obtain the correct magnetic course from the compass course, look in the first column for the compass course, the second column gives the deviation when the vessel's head is on that point, and the third column will be found the magnetic course.

In order to correct any bearings taken by the compass the table is to be entered with the direction of the ship's head at that time in the first column, and corresponding thereto in the second column will be found the amount of deviation to be applied, as per example: If a ship's head is NNE. the bearing of two islands be SE. and W. by S. by the compass. In the second column of the table and opposite to NNE. the deviation is 5° 40′ E.; applying this deviation to the right the correct magnetic bearing of the two islands will be S. 39° 20′ E., and S. 83° 55′ W., or roughly in points SE. ½ E. and W. ½ S.

The Chart is used to plot the position of the ship at any time and refer it to other known objects. Its construction has especial reference to the requirements of navigation. Thus the chart may be required for coasting purposes, in which case the harbor or coast charts are used, upon which are marked with great accuracy, the rocks, shoals, local cur-

rents, nature of the tides, soundings and channels as well as the different aids to navigation and their bearings.

For off shore cruising the **Mercator Chart** possesses so many advantages that it is universally adopted for sea purposes.

For the purposes of navigation and in order that the relative positions of places on the earth's surface may be laid down and quickly found, certain lines are supposed to be drawn upon the sphere.

These imaginary lines of reference are called **Parallels of Latitude** and **Meridians,** and when these are known for any given place its position upon the globe is precisely determined by their intersection.

The extremities of the axes of the earth are called the **Poles,** and the great circles passing through these poles are called **Meridians.** It is customary with us to call that meridian which passes through Greenwich the **First** or **Prime Meridian.**

The great circle drawn around the earth at equal distance from the poles, and perpendicular to the meridians, is called the **Equator.**

The equator and the prime meridian are the first lines of reference from which latitude and longitude are measured.

Latitude. The lines of latitude run due east and west, and are small circles of the sphere drawn parallel to the equator; we may conceive one of these drawn through every place. The portion of a meridian intercepted between a place and the equator is called the latitude, and is denominated north or south as the place is north or south of the equator.

Longitude. The longitude of a place is the portion of the equator intercepted between the prime meridian and the meridian passing over the place; is east or west according as the place is situated east or west of the prime meridian.

As every circle large or small is divided into 360 parts called degrees, it will be seen the equator and poles divide every meridian into four equal parts; therefore the greatest latitude a place can have is 90 degrees, and again the prime meridian divides the parallels of latitude into two equal parts, making 180 degrees the greatest longitude a place can have. Each of these degrees is divided into 60 minutes and the

minutes into 60 seconds. The minutes of the equator and of the meridians are each nearly 6080 feet long, and are called **Nautical** or **Sea Miles.**

The parallels of latitude being small circles and decreasing in size the nearer they approach the poles, while the meridians come together at the poles, it would be difficult to construct a chart easy to use in practice. However, upon the principles of Mercator a chart is constructed upon which the meridians are represented as being parallel to each other during their whole length, and the distance between the parallels of latitude is increased in the same proportion the nearer they approach the poles. This enables a course from one place to another to be laid down by a straight line between them, and the distance is obtained from the scale to the side of the chart as nearly opposite the two places as possible.

All charts are engraved true north and south, east and west, and in all the charts furnished by the Hydrographic Office the true compass is engraved in various places and the bearings given are the true bearings. Lines of variation are drawn upon the chart or the variation is given marked with each compass on the chart.

A current is marked on the chart by an arrow with two feathers pointing in the direction towards which it sets ⟹ And the drift or rate per hour at which it moves is marked in knots close to the arrow.

The set of the tide is marked on the chart by an arrow feathered on one side only for the flood ⟹ and by an arrow without feathers for the ebb tide ⟶

The tide is spoken of as *flood* when the water is rising, and as *ebb* when the water is falling; and to show when either occur, the time of high water at the full and change, that is to say at full moon and new moon, is given at the most important places on the chart. The hours are marked in Roman and the minutes in ordinary figures, thus, VII h. 50 m. For any particular spot this time of high water at the full and change may be considered practically constant. Any almanac will give the moon's age; but by a little practice it may be guessed within a day. When the moon looks like a D it is increasing or waxing, and when it looks like a C it is decreasing or waning.

The rise of **Spring Tides** or those which occur near the full and change of the moon, and the rise of the **Neap Tides** or those which occur near the 1st and 3d quarters of the

moon, are given in feet. Sometimes this information about the tides is given in a table on the chart.

Tides are caused chiefly by the moon, and as the moon is about 50 minutes later every 24 hours in coming over the same spot of the earth, the time of high water will be about 50 minutes later every day. In most places the tide rises twice in every 24 hours, which would make a regular interval of 12 hours between the times of successive high water, and 25 minutes additional for the retardation of the moon.

The calculations for finding the exact time of high water are puzzling, and require tables that may not be at hand. It is important to know the time, because in many channels it is only at high water that a vessel can get over the bar. First find the number of days from the last new or full moon, multiply this by 50, the number of minutes that the high tide is delayed each day, and add the product in hours and minutes to the time of high water given on the chart, A.M. or P.M., as the case may be. Or you can reckon forward the number of days to the *next* new or full moon, and then *subtract* the product from the time on the chart. The question whether you will reckon backwards or forwards depends on whether the last new or full moon, or the coming new or full moon, is furthest off. Of course you will reckon to whichever is nearest.

The time of high water obtained in this way may be depended upon within the hour, yet it may be out at times as much as two hours. The greatest error will occur during neap tides, hence by subtracting one hour from the time of high water at neap tide, will diminish this error. The following table will show how the rule works:

Before the new or full moon.	Subtract.
	hrs. min.
For 1 day	0 50
" 2 "	1 40
" 3 "	2 30
" 4 "	3 20
" 5 "	4 10
" 6 "	5 00
" 7 "	5 50*
After the new or full moon add the above times.	

* At neap tide subtract 1 h. from time of high water.

For example. The high water at full and change at Old Point Comfort is 8.46; at what time will it be high water on the 10th June, 1888?

From any almanac we find that in June the new moon occurs on the 9th in the afternoon, and the full moon on the 23d in the afternoon. Now the 10th of June is one day after the new moon, therefore to the above table we must add 50 minutes to 8.46, which gives 9.36 P.M. as the time of high water on the 10th of June.

Again, what time will it be high water on the 20th of June? Now the 20th of June is three days before the full moon, therefore, from the above table we must subtract 2.30 from 8.46, which gives 6.16 P.M. as the time of high water on the 20th of June.

The soundings marked on the chart are reduced to mean low water, and are generally given on the plain section in fathoms (of six feet) and fractions of a fathom; and on the shaded surface in feet and fractions of a foot.

Large charts are constructed for each ocean upon a too small scale for practical purposes when near shore, but to facilitate their use they are divided into marked sections accompanied with an index chart. These sectional charts have engraved upon them at the most convenient places, divided from the rest of the chart, a plan of the most important harbors upon a scale large enough for the various marks to be indicated and the nature of the channel understood.

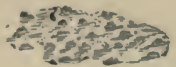
With the chart use is made of a pair of dividers and parallel rulers, the application of which will be shown in working some of the problems.

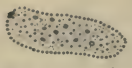
SIGNS AND ABBREVIATIONS MARKED ON THE CHART.

Nature of the Bottom.	General Abbreviation.
b. .. ..blue	An.....anchorage
blk.....black	Bk.....bank
br.....brown	C.....cape
brk.....broken	Ch.....church
c.....coarse	Chan.....channel
cl.....clay	Cr.....creek
crl.....coral	Fms.....fathoms
d.....dark	Ft.....feet or foot
f.....fine	H. W.....high water
g.....gravel	H. W. F. & C.....high water, full and change
gn.....green	I.....island
grd.....ground	Lat .....latitude
gy .....gray	Long.....longitude
h.....hard	Lt .....light
m.....mud	Lt. F .....light fixed
oys.....oysters	Lt. Fl.....light flashing
oz.....ooze	Lt. Int.....light intermittent
peb.....pebbles	Lt. Rev.....light revolving
r..... .....rock	Lt. Flg.....light floating
rot. .....rotten	Lt. Occ.....light occulting
s.....sand	Lt. Alt.....light alternating
sft. .....soft	L. W.... .....low water
sh.....shells	Mt.....mountain
spk.....speckled	Np.....neaps
st ... .stones	Obs. Spot.....observation spot
stf. .....stiff	Pk..... .....peak
w.....white	Pt.....point
wd.....weed	R.....river
y.....yellow	Rf.....reef
	R.....rock
	Sh.....shoal
	Sp..... .....spring
	Str.....strait
	Var.....variation
	Vis.....visible

CHARACTERISTIC SIGNS MARKED ON THE CHART.


CLIFFY COAST LINE


SWAMP OR MARSHY LAND


SAND WITH GRAVEL


ROCKS WITH DANGER-LINE


WIND MILLS


SHORE, STEEP TO SANDY BEACH

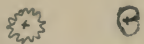

ROCKY LEDGES


SAND AND MUD

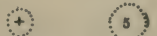
SHOAL AND DEPTH GIVEN


TOWN

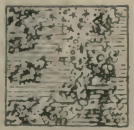

SAND HILLS


ROCKS UNDER WATER

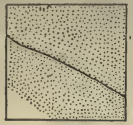

GRAVEL BANK

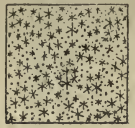


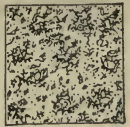
DOUBTFUL ROCKS


WOODED MARSH

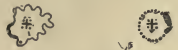

MANGROVE


SAND, HIGH AND LOW WATER


PINE

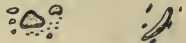

OAK


GRASS

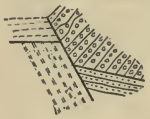

ROCKS AWASH


STONY BANK DRY AT LOW WATER


MOORING BUOY

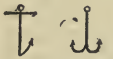

ROCKS IN SIGHT


MUD BANK, DRY AT LOW WATER


CULTIVATED GROUND


SAND, DRY AT LOW WATER


CORAL REEFS


ANCHORAGE FOR SMALL VESSELS

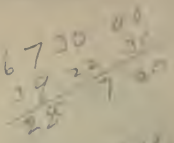

ANCHORAGE FOR LARGE VESSELS


TREES


SANDY BEACH


CHURCH


KELP



EXAMPLES.

I. The compass course is ESE., or S. 67° 30′ 00″ E. The variation and deviation 2¾ points E., leeway ¾ points right. What is the true course? *Ans.* S. 28° 07′ 30″ E.

II. The compass course is SSW., the variation being 1 point easterly. Find the true course. *Ans.* SW. by S.

III. An object bore by compass NE. by E. ¾ E., the variation being 1½ westerly. Find its true bearing. *Ans.* NE. ¼ E.

IV. Compass course is S. and the wind is NW., giving ¾ points leeway, variation 1 point E. and the deviation ¼ point W. Find the true course. *Ans.* S.

V. The true course is S. by W.; variation is 2 points W.; deviation is 5° W. Find compass course.

Ans. S. 38° 45′ W.

VI. The true course is W. by S., and the variation is 11° 15′ E., deviation is 9° W., wind NNE., leeway of 2 points. Find the compass course. *Ans.* N. 81° W.

VII. The compass course is SSE., with variation 2 points W., and deviation 5° E., the wind on the left hand giving 3 points leeway. Find the true course. *Ans.* S. 6° 15′ E.

VIII. The compass course is NE., and variation is 2 points E., deviation 2° E., wind on the right hand giving 3 points leeway. Find the true course. *Ans.* N. 35° 45′ E.

CHAPTER II.

Piloting or Coasting.

Having become thoroughly familiar with the instruments described, the ship is gotten underway and taken down the harbor or bay for an offing at sea. In doing this the rudest manner of navigation is used, called **Piloting or Coasting,** which requires only a local knowledge of the shore and its adjacent waters, together with the location of marks placed to aid navigation, all of which are given in the charts.

The effect of the tides and local currents along the shore is most treacherous, and may at any time cause the ship to be drifted out of the channel or into a dangerous position to some reef or shoal, to avoid which the actual position is often a matter of vital importance. A frequent cast of lead may give warning, and should be constantly kept going whenever on soundings, and carefully taken. If the ship is becalmed the ground log will indicate the direction and rate of drift.

Cross-bearings. When two known objects are in sight the ship's position is found by cross-bearings. Thus, as the ship proceeds down the channel the starting-point buoy bore per compass ENE., and a lighthouse N. ¾ W., while the ship's head was NW. Enter the deviation table, which should always be at hand in a little note-book, with the ship's head NW. in the first column, and the deviation to be applied in the second column is 4° 30′ W. Applying this to the left will give the magnetic bearings; and if the variation was 5° E., apply it to the right, and the true bearings will be:

	Starting Buoy	Lighthouse.
By compass.....	N. 67° 30′ E.	N. 8° 20′ W.
Deviation W.....	4° 30′ left	4° 30′ left
Magnetic bearing...	N. 63° 00′ E.	N. 12° 50′ W.
Variation E.....	5° 00′ right	5° 00′ right
True bearing.....	N. 68° 00′ E.	N. 7° 50′ W.

Apply the parallel ruler to the engraved compass on the chart lying along N. 68° E and the centre of the compass; then work the ruler until the edge touches the start buoy and draw a pencil line along its edge on the chart. Apply in like manner the N. 7° 50′ W. line to the lighthouse. Where these two lines cut each other will be the position of the vessel.

The bearings of these two points should not be too near each other, for then the lines would have a bad intersection; but if the two objects be in line, it is of great advantage, especially so when in the direction the ship is steering, as their separation will indicate a deviation from the channel.

Where the two lines cross, or the position of the ship, it is marked by a little pencil cross with the hour and date thus, $\times \frac{2\text{ P.M.}}{12/3}$, to identify it, which means the ship was in this position at 2 in the afternoon of March 12.

Bow and Quarter Bearing. A very simple means of finding the constant position of the ship is by what is known as the bow and quarter bearing. Take the bearing of one known object on shore when it is on the bow and measure the distance by log till it bears abeam; then the distance, should there be no current, will be the distance of the object when abeam.

Bearing of One Object. When it is impossible to get a bow and quarter bearing, such as having to change the course, the ship's position can be found by taking the bearing of the point when not in the direction the ship is sailing, and when the bearing has changed at least 3 points take a second bearing. Lay off from the given point the two bearings corrected for variation and deviation, and, after laying the parallel ruler in the direction of the true course, take the distance sailed in the dividers and move the ruler towards the given point till the distance fits exactly between the two lines and draw a pencil line. At the two points of intersection will be the first and second position of the ship.

Whenever the vessel is in the vicinity of land this method should frequently be used as a check to the influence of unknown currents.

By Sailing Directions or Chart. When the channel has long stretches winding between shoals or among islands, the sailing directions or chart gives the true or magnetic courses and bearings. Suppose they are magnetic, such as steer

NE., till a certain object bears N. by W., and then steer E. till another object bears SW. In such a case the magnetic course and bearing are given to find the compass course and bearing of the object. Look in the 3d column of the deviation table for the magnetic course, expressed in degrees and minutes.

If it be not one of the courses it will lie between two of them, and the corresponding compass course will lie between two courses in the 1st column and may be found by estimating. To find the compass bearing look in the 3d column for the magnetic course; opposite to it in the 2d column will be the deviation on that course.

Apply this deviation to the magnetic bearing to the left if the deviation is easterly and to the right if westerly.

EXAMPLE.

Suppose the chart should give directions to steer E. till a certain object bore N. by W., then steer SE. till another object bore SSW. magnetic.

In column 3, when the course was E., the deviation was between 6° 40′ E. and 7° 30′ E., or nearly ½ point E. Applying this to the left of the first course, the vessel should steer E. ½ N. by the compass till the first object bore by compass N. by W. ½ W. So from column 3 with the course SE. the deviation is between 2° 00′ E. and 3° 40′ E., or nearly ¼ point E. Applying this to the left of the second course, the vessel should steer SE. ¼ E. till the second object bore by compass S. by W. ¾ W.

In going around a point and no channel marked out, select several spots on the chart, the connection of which will permit the line joining them to pass over safe soundings. With the points of the dividers on two of the spots, transfer them to the scale and measure the distance; then with the edge of the parallel ruler along the line, move it to the nearest compass, and the point over which the edge comes will be the true course; correct this for variation and deviation to get the compass course. Put the ship's head on that course and sail the distance, when the same process will be repeated.

Should the ship be shut in by a fog or snow storm for a time out of sight of land, the channel and nature of the

bottom, as well as soundings by the hand or deep-sea lead, will give a close approximation to the position of the ship.

When the latitude and longitude are known, the position of the ship is plotted on the chart by laying the parallel ruler even with the nearest parallel of latitude marked on the side of the chart, and after moving it up to the given latitude draw a pencil line, which will represent the latitude of the ship; then measure with the dividers at the top and bottom of the chart the distance from the nearest meridian to the given longitude, which, set off on the parallel previously drawn with pencil, will be the ship's position.

To Verify the Deviation Table. When the vessel was swung in the harbor for deviation there might have been some local attraction unknown which would of course affect the local deviation table. To ascertain this, it is an excellent opportunity, as the vessel proceeds along the various courses in the channel, to verify the deviation table by frequent bearings of known objects on shore, or when two objects come in line. The chart will give their true bearings, and when converted to the compass bearings by the application of variation and deviation there should be no difference between this bearing and the compass; if so, the deviation is wrong and must be corrected before going to sea.

CHAPTER III.

Dead-Reckoning.

Shaping the Course. The vessel having now arrived at the point where it becomes necessary to commence her voyage at sea, the bearing and distance to the point it is intended to take the vessel are found from the chart by laying the ruler with the edge along the two places, then transfer the ruler to the nearest compass on the chart, which will give the true bearing. Correct the true bearing for variation and deviation to the left if easterly, and to the right if westerly, for the compass course, and the ship is kept as near that course as the wind and other circumstances will admit.

With the dividers, measure the distance on the scale to the side of the chart as nearly opposite the two places as it is possible.

If islands, capes, and headlands intervene, it will be necessary to find several courses and distances in the same way. This is called *Shaping the Course.*

Taking the Departure. When just about to leave the land take the bearing of some known object, such as a light-house or headland, by the compass and estimate the distance by eye, or the bearing and distance of the object from the ship. This may be found by one of the processes already described. This is called *Taking the Departure.*

Log-slate. The opposite point to that on which the object bears is considered the first course, and the distance of the object as the first distance sailed from the place and is noted on the log-slate. This *Log-slate* is a memorandum board or book properly ruled for the hours of the day, distance made by the log, courses steered by the compass and the direction of the wind, leeway, variation, and deviation, as well as remarks of all causes affecting the sailing of the ship.

Log-book. The other courses and distances made during the day being determined by the compass and the log are severally entered in the log-slate at the end of each hour, and afterwards copied into a book similarly ruled, called the *Log-book.*

It must be borne in mind that the standard compass is the compass from which all courses for the log-slate are taken. In steering, the course is taken from the standard compass and the man at the wheel given his course for the steering compass by a careful comparison. As the vessel proceeds on her course frequent comparisons should be made between these two compasses.

In a violent gale and heavy sea, when it would be dangerous to carry sail, it is usual to put the ship close to the wind with just sufficient sail to prevent the vessel from rolling too much. In this condition the vessel will come up and fall off, and the points to which her head comes up and falls off must be noted, and the middle point between the two taken as the course to enter in the log-slate.

If there should be a set and drift of a current it is to be entered as a course and distance, and treated the same as any course and distance.

Dead-reckoning. The process by which the position of the ship is found from the data given in the log-book is called *Dead-reckoning*. By means of this dead-reckoning the latitude and longitude are found, hence the position of the ship. It is usual to obtain the position at 8 A.M., 12 M., and 8 P.M. of each day, and more frequently when approaching land or danger.

The process by which this is accomplished is, first, correct the several courses in the log-book for the variation, deviation, and leeway opposite to each course. Construct a table in the *Work-book*, in which all data in navigation should be preserved during the entire voyage. In the first column of this table enter each true course, and in the second column the distance run on each course, found by summing up the knots and tenths sailed by the ship on each course.

Find in Table I the courses at the top or bottom of the page given in degrees, the *difference of latitude* and the *departure* corresponding to each course and distance, and place them in their respective columns; then the difference between the sums of the *northings* and *southings* will be the *difference of latitude made good* of the same name as the greater.

Seek in the same table until the difference of latitude and departure are found together in their respective columns; opposite to these in the distance column will be the *distance made good.*

At the top or bottom of the page, according as the departure is less or greater than the difference of latitude, will be found the *course made good.*

If the latitude of the object from which the departure was taken or the latitude of a former position be of the same name as the difference of latitude found, add them together; but if of different names take their difference; the sum or remainder will be the *latitude in* of the same name as the greater.

As departure is the lineal distance between two meridians measured upon a parallel of latitude, it is less than the difference of longitude, which is measured upon the equator; so to find the difference of longitude take the middle latitude between the two places which take as a course in Table I., and seek for the departure in the difference of latitude column; then will the corresponding distance be the *difference of longitude* of the same name as the departure. If the longitude of the previous

position be of the same name as the difference of longitude add them together, but if of different names take their difference; the sum or difference will be the *longitude in* of the same name as the greater.

The intersection of the latitude and longitude found on the chart will be the position of the ship, from which the bearing and distance of the port or other object can again be found. It is especially important to always find the bearing and distance of any supposed or real danger whenever the position of the ship is plotted

EXAMPLE.

When the ship was about to leave the land on July 15th, the departure was taken from Cape Henry light-house, which bore per compass NNW., distance 20 miles; afterwards sailed by the following log account:

LOG-BOOK OR SLATE-TABLE.

Hours.	Knots.	Tenths.	Courses.	Wind.	Leeway.	Var.	Dev.	True Courses.	Remarks.
noon	20	0	SSE. Departure.			10°	0 30 W.	S. 33 00 E.	
1	6	5	SE. by E.	NE.	1 pt.	,,	3 40 E.	S. 51 20 E.	
2	5	0	"	"	"	,,	"	S. 51 20 E.	
3	6	0	SE.	ENE.	2 pt.	,,	2 00 E.	S. 30 30 E.	
4	5	5	ESE.	S.	"	,,	4 30 E.	S. 28 00 E.	
5	5	0	E. by N.	SSE.	"	,,	7 30 E.	N. 53 45 E.	
6	5	0	"	"	"	,,	"	N. 53 45 E.	
7	5	0	"	"	"	,,	"	N. 53 45 E.	
8 P.M.	5	0	NE.	SE.	1 pt.	,,	8 00 E.	N. 31 45 E.	A current set the ship during the last 2 hours 1-2 m. an hour SW. and from NE. Mod. breeze, smooth sea on, sail, etc.
	3	0	Current true SW.			....	....	S. 45 00 W.	

In this case the opposite point to the bearing of the light-house NNW. is SSE., which enter as the first course and the distance 20 miles as the first distance. The variation supposed to be found on the chart was 10° W., and from the deviation table for the course SSE. we find 00° 30′ W., which, applied to the left as they are both westerly, gives the true course S. 33° 00′ E.

Again, for the second course at 1 P.M. the log indicated the ship as making 5 miles the first hour and the compass course SE. by E. with the wind NE. or on the port tack, the left side; hence the leeway of one point is to the right. The variation

of 10 degrees is west or left, and the deviation from the table 3° 40′ is east or right; hence the true course is S. 51° 20′ E. in the last column, and so on with the other courses.

The drift of the current being one and a half miles per hour for the last two hours drove the ship 3 miles in the direction of the set SW. true, which enter as though the ship had sailed that the last course and distance.

Having now obtained the true courses sailed, enter them in the table of the working-book with the sum of the distances made on each course:

WORK-TABLE.

Courses.	Distances.	Diff. Latitude.		Departure.	
		N.	S.	E.	W.
° ′					
S. 33 00 E.	20.0		16.8	10.9	
S. 51 20 E.	11.5		7.2	8.9	
S. 30 30 E.	6.0		5.2	3.0	
S. 28 00 E.	5.5		4.8	2.5	
N. 53 45 E.	15.0	8.8		12.1	
N. 31 45 E.	5.0	4.2		2.6	
S. 45 00 W.	3.0		2.1		2.1
		13.0	36.1	40.0	2.1
			13.0	2.1	
		Diff. Lat.	23.1	37.9	Departure.

Course made good S. 58° E. and distance made good 44 miles.

Lat. Cape Henry Light 36° 55′ 05″ N. Long. 76° 00′ 02″ W.
Difference of latitude 23′ 06″ S. Diff. Long. 47′ 00″ E.

Latitude in . . . . 36° 31′ 59″ N. Long. in 75° 13′ 02″ W.

Sum of latitudes . . 73° 27′ 04″
Middle latitude . . 36° 43′ 30″ or 36½°.

The first course, 33°, is found at the top of the page of Table I, and opposite to the distance of 20 the Lat. column gives 16.8 and the Dep. column gives 10.9, which place in their appropriate column in the work-table; the difference latitude under S. and the departure under E. as the ship has sailed south and

east. Do the same way with each course to the nearest degree is sufficient.

After adding up the different columns it will be seen there were more southings than northings, and their difference will give 23.1 S. as the difference of latitude made good. There are more eastings than westings, and their difference will give 37.9 E., the departure made good.

In Table I the place where these come nearest in their respective columns is opposite 44 in the distance column, which is the distance made good.

The departure being greater than the difference of latitude, the course made good is found at the bottom of the page, S. 58° E.

The latitude of Cape Henry being north and the difference of latitude made good being south we take their difference and get the latitude in 36° 31′ 59″ N., the name of the greater.

With the middle latitude 36¾ as a course in Table I, the departure made good is found in the Lat. column opposite the distance 47, which is the difference of longitude of the same name as the departure, which is east, and as the longitude of Cape Henry is west we take their difference to find the longitude in 75° 13′ 02″ W., the name of the greater.

From this new position of the ship the bearing and distance of the designated place are again found, and the new course followed as nearly as possible.

From 8 P.M., the time of the last position, the ship sailed on a course by compass ESE., with the wind free, 100 miles per log until 8 A.M. the following morning; the chart showing 2 points easterly variation and a constant drift of 2 miles per hour in a true SW. direction. Find the position again. In this case there would not be any leeway.

LOG-TABLE.

Hours.	Knots.	Courses.	Wind.	Lee.	Var.	Dev.	True courses.
12	100 24	ESE. Set of	NW. the cur	0 rent	2 pts. E. SW. true.	4° 30′ E.	SE. ½ S. SW.

The variation 2 points being easterly and the deviation from the table 4° 30′ E. or nearly ½ point easterly, both are applied to the right to get the true course.

WORK-TABLE.

Courses.	Distance.	Diff. Latitude.		Departure.	
		N.	S.	E.	W.
° ′ ″ S. 39 22 30 E. S. 45 00 00 W.	100 24		77.3 17.0	63.4	17.0
			94.3	63.4 17.0	17.0
		Diff. Lat.	94.3	46 4	Departure.

Course made good S. 26° E., and 105 miles the distance made good.

In this case, the nearest the difference of latitude and departure came together in their appropriate columns in Table I. was opposite to 105, the distance made good. As the departure was less than the difference of latitude the course S. 26° E. or SSE. ½ E. was found on top of the page as the course made good.

Latitude of last position	36° 31′ 59″ N.
Difference of Latitude .	1° 34′ 18″ S.
Latitude in	34° 57′ 41″ N.
Sum of the Latitudes .	71° 29′ 40″.
Middle Latitude . . .	35° 44′ 50′ or 35¾″.

With this middle, latitude 35¾, enter Table I, and find departure in the Lat. column, and opposite to it in the distance column is 57 miles, the difference of longitude of the same name as the departure, which is east.

Longitude of the last position	75° 13′ 02″ W.
Difference of longitude . .	57′ E.
Longitude in	74° 16′ 02″ W.

At noon of that day the ship was found by the log to have sailed 30 miles NE. by E. close to the wind on the starboard tack or right hand, making two points leeway. Variation by the chart 7° 30′ W.

From the deviation table the deviation on a NE. by E. course is 8° 10′ E. The leeway will be to the left.

Compass course NE. by E. is N. 56° 15′ 00″ E.
Deviation E. . . . . 8′ 10″ to the right.

Magnetic course N. . . . . 64° 15′ 00″ E.
Variation W. . . . . 7′ 30″ to the left.

True course N. . . . . 56° 45′ 00″ E.
Or nearly N. 57° E.

WORK-TABLE.

Courses.	Distance.	Diff. Latitude.		Departure.	
		N.	S.	E.	W.
N. 57 E.	30	16.3		25.2	
		16.3		25.2	
		16.3	Diff. Lat.	25.2	Departure.

Course made good N. 57° E., and 30 miles the distance made good.

Lat. left 34° 57′ 41″ N.
Diff. Lat. 16′ 18″

Lat. in 35° 13′ 59″ N.
Sum of Lats. 70° 11′ 40″
Mid. Lat. 35° 05′ 50″

With the middle latitude 35 and the departure 25.2 in the Lat. column, the difference of longitude is found to be:

Diff. longitude 31′ 00″ E.
Longitude left 74° 16′ 02″ W.
Longitude in 73° 45′ 02″ W.

From this position the ship sailed from day to day on the following courses and distances, taken from the log-book and stated in the following table:

LOG-BOOK.

Courses.	Distances.	Wind.	Leeway in Points.	Var.	Dev.	True courses.
				° ′	° ′	° ′
ENE.	30	N.	1¼	15 20 W.	7 20 E.	N. 73 33 45 E.
E. by N.	40	NNE.	2	10 10 W.	7 30 E.	S. 81 35 00 E.
E by S.	80	"	1¾	5 00 E.	5 50 E.	S. 48 14 00 E.
E.	60	"	2	7 00 E.	6 40 E.	S. 53 50 00 E.
SE	30	Drift.....		7 00 E.	2 00 E.	S. 36 00 00 E.
ENE.	50	Current, true course				N. 67 30 00 E.

Remarks.—The ship drifted during the time in a gale by wind and sea 30 miles SE. by compass. By current marked in chart ENE. 50 miles.

In the second course it will be seen that after variation and deviation and leeway are applied, the course is greater than 90 degrees, or we have gone through E. from the north and have come nearer S. than N.; therefore we subtract from 180 degrees, which gives the true course S. 81° 35′ E. from the South.

WORK-TABLE.

Courses.	Distances.	Diff. Latitude.		Departure.	
		N.	S.	E.	W.
° ′					
N. 73 34 E.	30	8.6		28.7	
S. 81 35 E.	40		6.0	39.5	
S. 48 14 E.	80		53.3	59.7	
S. 53 50 E.	60		35.3	48.5	
S. 36 00 E.	30		24.3	17.6	
N. 67 30 E.		19.1		46.2	
		27.7	118.9	240.2	
			27.7		
		Diff. Lat.	91.2	240.2	Departure.

Course made good S. 69° E. and 257 miles made good.

With the first course enter Table I with the course 73. On page with 73 at the bottom and opposite to 30 in the distance column will be found in the Lat. column 8.8, and on page with 74 at the bottom and opposite to 30 in the distance column will be found in the Lat. column 8.3, making a difference of .5 for one degree in the course: hence for half a degree it will be one half of .5, or .2, to be subtracted from 8.8 in the first case, which will give 8.6 for the difference of latitude for the first course, which place in the column N. as northings. As there is so little difference between the departure for 73 and 74, that for either course may be used as the departure in its appropriate column under E., and so on in each course.

Lat. left	35° 13′ 59″ N.
Diff. Lat.	1° 11′ 12″ S.
Lat. in	34° 02′ 42″ N.
Sum of Lats.	69° 16′ 46″
Mid. Lat.	34° 38′ 23″

With middle latitude 34½ and the departure 240.2 in the Lat. column, the difference of longitude is found to be 291.5 in the distance column; divide by 60 and we get:

Diff. longitude	4° 51′ 30″ E.
Longitude left	73° 45′ 02″ W.
Longitude in .	68° 53′ 32″ W.

Continue in this way until the port is reached.

If it is not convenient to find the course and distance on the chart with the parallel rulers and dividers, it may be done in the following manner. Suppose, for instance, it is desired to know the compass bearing and distance from the last position back to Cape Henry.

Lat. of Cape Henry 36° 55′ 05″ N.
Lat. of last position 34° 02′ 47″ N.

Diff. Latitude 2° 52′ 18″
60

120
52

172.3

Long. of Cape Henry 76° 00′ 02″ W.
Long. last place 68° 53′ 32″ W.

Diff. Longitude 7° 06′ 30″
60

426.5

Sum of Latitudes 70° 57′ 52″
Middle Latitude 35° 28′ 56″ or 35½

The difference of longitude is too great for the distance column in the table, so divide it by 2 for convenience, and with the half of the longitude, 213.2, enter Table I, and opposite to it in the distance column for 35 and 36 will be found 174.5 and 172.3 in the latitude column; the middle latitude being nearly 35½, take the mean of these, 173.4, for the departure, which multiplied by 2 gives 346.8 for the whole departure. The whole departure and difference of latitude are too large for the table, so divide by any convenient number, say 10, which gives 17.2 diff. latitude and 34.7 departure; with these seek in Table I till they nearly agree on a course S. 63° W. and a distance of 39. Multiply this distance by 10, and we get 390 miles as the whole distance.

Hence Cape Henry bears true S. 63° W., distance 390 miles; and to get the compass bearing or course, variation and deviation must be applied. Let variation be 16° 20′ W.

True course S. 63° 00′ W.
Variation W. 16° 20′ apply to the right.

Magnetic course S. 79° 20′ W.
Deviation W. 8° 00′ to the nearest point to the right.
Compass course S. 87° 20′ W.

Or the ship will have to steer S. 87° 20′ W. 390 miles to return to Cape Henry.

Ship's Track. It is customary, whenever the position of the ship is plotted, to draw a line on the chart from that position to the former one, and the lines so drawn from day to day will be the ship's track—a distinction from the *traverse* which the ship makes in her zigzag course sailing from one position to another against a head wind.

EXAMPLES.

I. Required the compass course and distance from latitude 51° 25′ N. and longitude 9° 29′ W., to latitude 49° 16′ N. and longitude 9° 29′ W. The variation is 19° 20′ W. and deviation is 3° 16′ E.

Ans. Compass course S. 16° 04′ W. Distance 129 miles.

II. A ship sails from latitude 44° 30′ N. 290 miles, when she finds her departure is 161.1. What is the true course she has sailed, the difference of latitude, and latitude in (to N. and W.)?

Ans. Course NW. by N. Diff. latitude 241.1 and Latitude in 48° 31′ 06″ N.

III. What is the position of the ship after sailing on the following courses (true) and distances: NNE. 40 miles; E. by S. 60 miles; SE. 70 miles; and SW. 48 miles?

Ans. Diff. lat. 58.2; dep. 89 7; course made good S. 57° 01′ E.; distance 106.9.

IV. A rock was sighted in latitude 39° 40′ S., longitude 87° 15′ E., bearing NNE., distant 15 miles. Afterwards sailed: E. by S., 37 miles; ENE., 44 miles; N. ¼ W., 51 miles; and ESE., 29 miles. What is the position of the ship? (The bearings and courses are true.)

Ans. Course made good N. 70° E.; distance 102 miles. Latitude in 39° 05′ S.; longitude in 89° 17′ E.

V. From latitude 18° 35′ S., longitude 123° 23′ E., the ship sails 225 miles SW. ¼ W. by compass. What is her position? The variation is 1½ point E. and deviation is 6° 35′ W.

Ans. Latitude in 20° 24′ 06″ S.; longitude in 119° 55′ 00″ E.

VI. A danger bears by compass S. 34 E. 29 miles, variation is one point west, and deviation is 1° 50′ E. What is the true bearing of the danger? The latitude of the danger is 00° 52′ N. and longitude is 2° 40′ E.

Ans. N. 43° 25′ W., 29 miles.

CHAPTER IV.

By Observations.

The method of finding the ship's position by dead-reckoning must of course be liable to many errors, arising from the great difficulty in steering a steady course, different rates of sailing between the times of heaving the log, incorrect allowance for leeway and variation, and more frequently from the effects of the drift of the sea and unknown currents; hence it becomes necessary to determine the position by celestial observations when the opportunity offers.

The Zenith. The heavens appear to form the upper half of a hollow sphere, and this celestial surface may be conceived to be divided by imaginary circles that are made to correspond with those of the earth; thus if the axis of the earth were extended it would pass through the north and south poles of the heavens. The celestial equator is a circle in the heavens corresponding with the equator of the earth, and the celestial meridians correspond also with those of the earth; hence it will be seen that if we determine the point immediately over head, called *The Zenith*, it would be the same as finding the position of the ship on the earth. The method for finding this position differs from that of dead-reckoning in the determination of the position directly from observations of the heavenly bodies and not by a reference to some other geographical spot.

The instruments used to obtain the data necessary for the determination of the position by observations are the **Chronometer** and **Sextant.**

The Chronometer is a superior kind of watch, so constructed that its daily gain or loss by variation of temperature

is reduced to a minimum. The machinery is of such delicate construction that the greatest possible care must be taken of it both at sea and in harbor. It should never be moved from its place on board, but kept as near the same temperature as possible, and is defended from violent shocks by the case being lined with soft wool and preserved in a horizontal position by being hung on gimbals. It should be wound up every day at the same hour and the key turned steadily through each turn.

Error and Rate. The chronometers are intended to keep the mean time of Greenwich, but as none of these are perfect the *Error* should be ascertained before going to sea and also its *Daily Rate.*

The error is said to be *fast* or *slow* as the chronometer is fast or slow of Greenwich mean time. The daily rate is the change in its error in twenty-four hours, and if the instrument is going too fast the rate is said to be *gaining:* if too slow, *losing.*

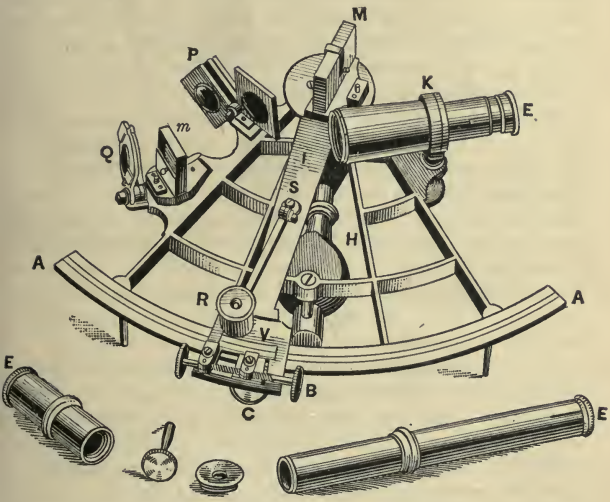
A chronometer is best rated at an observatory; but at all large sea-ports an electrical ball is dropped at a certain hour every day from a point at which it can be seen from all over the harbor. By a comparison with this the error can be found, and if taken in successive days the rate. In the absence of this some good clock-maker can be found to compare your chronometer with one of known rate and error.

After going to sea the rate is almost sure to change some; and it is not unwise, on arriving in port, to compare with the chronometers of other ships, should there be no time-ball. The difference between the two rates being divided by the interval elapsed will be what is called the *sea rate.*

The Sextant is an instrument used to measure the altitude of a heavenly body above the horizon, or the angular distance between objects. The description, names, and uses of the different parts may be best learned from the instrument itself, which may be found in almost any optician's store.

From the figure the names of the different parts may be seen. *AA* is the limb; *I*, the index-bar; *M*, the index-glass, which stands upon and moves with the index-bar; *m* is the horizon-glass fixed to the frame, and which is only silvered on half the surface; *P* and *Q* are the shade-glasses to modify the brightness of the sun; *E* is the sight-tube or telescope carried by the collar *K*; *R* is the magnifying-glass to assist in reading the

scale, is attached to an arm which moves upon a pivot S; B is the tangent-screw to give a small motion to the index-bar



THE SEXTANT.

when the clamp-screw is tight. C is the clamping-screw, and V is the vernier carried by the index-bar.

The limb is graduated to 120° from the zero point and to a few degrees on the opposite side of the zero point. The degrees are divided at every ten or twenty minutes, and these are subdivided by the vernier to ten or twenty seconds, thus enabling the angles to be read by estimating to five or ten seconds.

The Adjustments are four in number. I. See if the index-glass is perpendicular to the plane of the instrument by placing the index near the middle of the limb, and whilst looking in the index-glass see if the reflected limb in the glass forms an unbroken line with the limb itself; if not, make it so by means of the screws at the back of the glass.

II. See if the horizon-glass is perpendicular to the plane of the instrument, by looking through the sight-tube and the horizon-glass at the horizon and holding the instrument in a

vertical position, move the index till the reflection of the horizon in the silvered part of the glass forms an unbroken line with the one seen direct, fasten the index by the clamp-screw and incline the instrument to the right or left to see whether the true and reflected horizons continue to form an unbroken line; if not, they can be made so by means of the screw at the back of the instrument.

III. See that the axis of the telescope, when screwed into the collar, is parallel to the plane of the instrument by placing two of the wires of the telescope parallel to the plane of the instrument, and then measure the distance between two objects more than 90° apart, and bring them in contact on the wire nearest the instrument; by moving the sextant slightly the two objects may be brought to the other wire; if they still be in contact the adjustment is correct, but if they separate or top one over the other, the adjustment is made by means of the screws in the collar of the telescope.

IV. See that the horizon-glass is parallel to the index-glass when the zero of the vernier is opposite to zero on the limb by looking at the horizon and holding the instrument in a vertical position. Place the two zeros together and look through the horizon glass at the horizon, holding the instrument vertical. If the true horizon through the clear part of the glass appear in a straight line with the reflected in the silvered part the two glasses are parallel; if not they are made so by turning the lower screw at the back of the glass.

Index Error. If this last adjustment has not been correctly made the instrument can be used as well, but the reading will want correction for every angle measured; this correction is called the *Index Error*. This error is found by making the horizons form an unbroken line whilst holding the instrument in a vertical position, and the distance from zero on the limb to the zero on the vernier will be the index error, to be subtracted from the angles measured if zero on the vernier is to the left of zero on the limb, otherwise add. A more accurate way is by measuring the diameter of the sun on both sides of zero. If both measurements read alike there will be no index error; if they are unlike, half their difference will be the index error, to be subtracted if the measurement taken on the left of zero is larger; otherwise, to be added.

To Take an Altitude. When taking an altitude of the sun

it is customary to bring the sun's lower limb in contact with the horizon, but if the lower limb is obscured the upper limb can be used. As no level or plumb-line can be used in taking the altitude the sextant should be held as nearly perpendicular as possible, and when the reflected image is brought down to the horizon by moving the index by hand clamp it there, and while sweeping the horizon the image will appear to form a curve ; use the tangent-screw till the limb just touches the horizon at the lowest part of the curve.

The altitude when thus taken on the meridian enables us to find the latitude, and when not taken on the meridian furnishes the means of finding the time of the ship and thence the longitude. This altitude above the sea horizon is called the *Apparent Altitude* and must be corrected to reduce it to the *True Altitude*. These corrections are : *dip, index error, refraction, parallax,* and *semi-diameter.*

The Dip is the depression of the sea horizon below the level of the eye, and will depend upon the elevation of the eye above the level of the sea ; should be subtracted from the apparent altitude because it makes the altitude appear more than it really is. The dip is given in Table II.

Refraction is due to the earth's atmosphere, which bends the rays of light passing through it into a position more nearly vertical and thus enabling us to see a heavenly body when really below the horizon. The effect then of refraction is to make the heavenly body appear higher than it really is ; hence the correction for refraction must be substracted from the apparent altitude. This correction depends upon the altitude of the heavenly body being most when near the horizon and nothing when in the zenith. The refraction is given in Table II.

Parallax is a correction to be added to the apparent altitude to make it what it would have been if observed at the centre of the earth. The parallax decreases with the altitude, being most when in the horizon and nothing when in the zenith. Parallax is given in Table II.

Semi-diameter is the correction to be applied to obtain the altitude of the centre of the object. If the lower limb of the sun was used it should be added to the apparent altitude and subtracted when the upper limb is used. *The semi-diameter of the sun may be taken at* 16′.

CHAPTER V.

To Find the Latitude.

Astronomical Date. In finding certain data from the tables the astronomical date is used, which begins 12 hours behind the *civil date*, and is counted from noon to noon, or 24 hours, whereas the civil date commences at midnight and is divided into two parts of 12 hours. Suppose the day is what is ordinarily called the 4th July, and it wants 2 hours to noon, it would be 10 A M. of the 4th July civil date, but astronomically it is July 3d, 22 hours.

To Find the Latitude. The latitude of a place, being its distance from the equator measured on the meridian, must correspond with the distance from the celestial equator to the zenith. As the zenith is right overhead, it is 90 degrees from the horizon ; hence, if the celestial equator were visible in the heavens, it would only be necessary to take its altitude, which subtracted from 90 would give the latitude. As we cannot see the equator, some heavenly body is taken whose distance from the equator is known. In case of the sun, it appears to move during the year in a path inclined to the equator at an angle of 23 degrees and 28 minutes, crossing the equator twice during the year, once in March and again in September, reaching its farthest north in June and farthest south in December. Its distance at any time from the equator measured on a meridian is called its **Declination,** *north when it is north of the equator, and south when south of it.*

The declination is given in Table III for each month when the sun is on the meridian of Greenwich; and as the declination is constantly changing, the difference for one hour is also given in the table.

To find the declination at any time, obtain the astronomical date, and take from Table III the declination opposite the day of the month ; now multiply the difference for one hour by the longitude in time, which is one hour for every 15 degrees, and, if the declination be increasing, add in west but subtract in east longitude. If the declination be decreasing, subtract in west but add in east longitude.

The **Meridian Altitude** of the sun is the greatest it will acquire during the day, and as it crosses the meridian it is necessary to commence taking its altitude a little before, and keep its image in contact with the horizon till it begins to fall. Correct this altitude to find the true altitude according to the principles previously explained, and to avoid any mistakes it would be best to prefix the signs of addition and subtraction, + and −, to the known corrections and those that are found in Table II. These corrections may be written in a separate form, and applied one to the other according to their several signs for a whole correction to be added or subtracted as the sign implies.

Meridian Zenith Distance. As the zenith is 90 degrees from the horizon, subtracting this true meridian altitude from 90 will give the distance of the sun from the zenith while on the meridian, or the *meridian zenith distance. This meridian distance mark north when the sun bears south, or south when it bears north.*

Now with the meridian zenith distance given and the declination known, the latitude is found by adding them together if they are of the same name, or taking their difference if of different names. The latitude will be of the same name as the greater.

EXAMPLES.

At sea, June 21, 1887, in longitude 60° W., the observed altitude of the sun's lower limb was 40° 04′ ; sun bearing south ; index correction 3′ 00″ (add) ; height of the eye 20 feet. Find the latitude.

In Table III, with the year at the top and the day of the month at the left of the page, we find the declination under June to be 23° 27′ N., and the corresponding difference for one hour to be zero. This difference for one hour multiplied by four hours, the longitude (60 divided by 15), gives for the correction to the declination nothing ; hence the true declination is 23° 27′ 00″ N.

The observed altitude, 40° 04′, having been corrected as before explained, the true altitude is found to be 40° 17′ 35″, which subtracted from 90 gives the meridian zenith distance 49° 42′ 25″, which is marked north as the sun bore south.

The declination and meridian zenith distance having the

same name, we take their sum and find the latitude to be 73° 09′ 25″ N.

For the sake of convenience it is always best to have a particular form for all problems in which the data are written and the result obtained; besides it tends to preserve neatness in the navigation book, and facilitates an easy means of comparison with other results.

The form in this case should be:

Obs. Alt. 40° 04′ 00″	S. D. + 16′ 00″
Corr. + 13 35	I. C. + 3 00
	Ref. − 1 09
True Alt. 40 17 35	Dip − 4 23
90 00 00	Par. + 07
M. Z. D. 49 42 25 N.	Cor. + 13 35
True Dec. 23 27 00 N.	
Latitude 73 09 25 N.	
Dec. 23° 27′ 00″ N.	Hr. Diff. 0″
Corr. 00 00	Long. 4 hrs.
True Dec. 23 27 00 N.	Corr. 0

At sea June 1, 1886, in longitude 48° 40′ W., the observed altitude of the sun's lower limb was 72° 14′ 10″; sun bearing south; index error + 3′ 45″; height of the eye 22 feet. Find the latitude.

Longitude 48° 40′ W. is 3 hrs. 14 m. 40 s. W., or 3¼ hrs. nearly.

Obs. Alt. 72° 14′ 10″	S. D. + 16′ 00″
Corr. + 14 54	I. C. + 3 45
	Ref. − 0 18
True Alt. 72 29 04	Dip − 4 36
90 00 00	Par. + 3
M. Z. D. 17 30 56 N.	Corr. + 14 54
True Dec. 22 06 05 N.	
Latitude 39 37 01 N.	
Dec. 22° 05′ 00″ N.	Hr. Diff. 20″
Corr. + 1 05	Long. 3¼ hrs
True Dec. 22 06 05 N.	Corr. + 65″ or + 1′ 05′

At sea June 25, 1886, in longitude 59° 15′ E. (3 h. 57 min.), the observed altitude of the sun's upper limb was 60° 23′ 14″; sun bearing north; index error − 2′ 21″; height of the eye 30 feet. Find the latitude.

Obs. Alt.	60° 23′ 14″	S. D.	− 16′ 00″
Corr.	− 24 12	I. C.	− 2 21
		Ref.	− 33
True Alt.	59 59 02	Dip	− 5 22
	90 00 00	Par.	+ 4
M. Z. D.	30 00 58 S.		
True Dec.	23 24 15.8 N.	Corr.	− 24 12
Latitude	6 36 42.2 S.		
Dec.	23° 24′ 00″ N.	Hr. Diff.	4″
Corr.	15.8	Long.	3.95 hrs.
True Dec.	23 24 15.8 N.	Corr.	+ 15″.80

At sea October 3, 1887, in longitude 67° 30′ W., the observed meridian altitude of the sun's lower limb was 40° 23′ 50″; sun bearing N.; index correction + 1′ 30″; height of the eye 18½ feet. Find the latitude.

Obs. Alt.	40° 23′ 50″	S. D.	+ 16′ 00′
Corr.	+ 12 20	I. C.	+ 1 30
		Ref.	− 1 07
True Alt.	40 36 10	Dip	− 4 11
	90 00 00	Par.	+ 08
M. Z. D.	49 23 50 S.	Corr.	+ 12 20
True Dec.	4 00 21 S.		
Latitude	53 24 11 S.		
Dec.	3° 56′ 00″ S.	Hr. Diff.	58″
Corr.	+ 4 21	Long.	4.5 hrs.
True Dec.	4 00 21 S.		290
			232
			261″0
		Corr.	+ 4′ 21″

At sea Feb. 21, 1888, in longitude 45° W., the observed meridian altitude of the sun's lower limb was, 55° 43′ 10″; sun

bearing S.; index correction — 2′ 10″; height of the eye 19 feet. Find the latitude.

Obs. Alt.	55° 43′ 10″	S. D.	+ 16′ 00″
Corr.	+ 8 59	I. C.	— 2 10
		Ref.	— 40
True Alt.	55 52 09	Dip	— 4 16
	90 00 00	Par.	+ 5
M. Z. D.	34 07 51 N.	Corr.	+ 8 59
True Dec.	10 35 18 S.		
Latitude	23 32 33 N.		
Dec.	10° 38′ 00″ S.	Hr. Diff.	54″
Corr.	— 2 42	Long.	3 hrs.
True Dec.	10 35 18 S.		162″
		Corr.	— 2′ 42″

At sea Jan. 23, 1888, in longitude 4 hours and 12 minutes E., the observed meridian altitude of the sun's lower limb was 77° 15′ 30″; sun bearing N.; index correction — 3′ 10″; height of the eye 19 feet. Find the latitude.

Obs. Alt.	77° 15′ 30″	S. D.	+ 16′ 00″
Corr.	+ 8 23	I. C.	— 3 10
		Ref.	— 0 13
True Alt.	77 23 53	Dip	— 4 16
	90 00 00	Par.	+ 0 02
M. Z. D.	12 36 07 S.	Corr.	+ 8 23
True Dec.	19 32 27 S.		
Latitude	32 08 27 S.		
Dec.	19° 30′ 00 S.	Hr. Diff.	35″
Corr.	+ 2 27	Long.	4.2 hrs.
True Dec.	19 32 27 S.		70
			170
			147″.0
		Corr.	+ 2′ 27″

At sea April 20, 1888, in longitude about 40° 15′ W., the observed meridian altitude of the sun's lower limb was 63°

01′ 30″; sun bearing N.; index correction − 3′ 10″; height of the eye 19 feet. Find the latitude.

Obs. Alt.	63° 01′ 30″	S. D.	+ 16′ 00″
Corr.	+ 8 09	I. C.	− 3 10
		Ref.	− 0 29
True Alt.	63 09 39	Dip	− 4 16
	90 00 00	Par.	+ 0 04
M. Z. D.	26 50 21 S.	Corr.	+ 8 09
True Dec.	11 48 18 N.		
Latitude	15 02 03 S.		
Dec.	11° 46′ 00″ N.	Hr. Diff.	51″
Corr.	+ 2 18	Long.	2.7 hrs.
True Dec.	11 48 18 N.		137″.7
		Corr.	+ 2′ 17″.7

CHAPTER VI.

To Find the Longitude.

The earth in its revolution about its axes from west to east once in twenty-four hours causes the sun to pass over 360 degrees in that time, which is equal to 15 degrees per hour. As longitude is measured on the equator in degrees, minutes, and seconds, we have at once the connection between it and time, or 15° is equivalent to one hour, 15′ to one minute, and 15″ to one second. As the motion of the sun is from east to west, apparently, it follows that all places east of us will have the sun on their meridian before it comes to ours, therefore it will be later there than at our place; and all places to the westward of us will have the sun on their meridian after it has passed ours, therefore it will be earlier there than at our place. Now, it has been stated, the first meridian, from which all longitudes are reckoned, is the one passing over Greenwich; hence the difference of time between Greenwich and any place is the longitude of that place. To find the longitude, then, of any place would be to find the time of the place and apply it to the Greenwich time.

As the sun, which is supposed to mark the days and hours by its passage in the heavens, is irregular in its motion, it is necessary to take into consideration, besides the two modes of counting dates, two kinds of time—*apparent time* and *mean time*.

Apparent Time is that shown by the sun, estimating the apparent noon the moment the sun passes the meridian, and if it were possible to determine that moment with accuracy at sea, we could then obtain the apparent time at ship; but the length of the days would vary as much as half an hour during the year if they were determined by the sun's passage over the meridian.

Mean Time. As it is impossible to construct watches or chronometers to show this apparent time, we make use of what is called mean time, which makes the days of uniform length throughout the year, and is therefore sometimes in advance of the time shown by the sun and sometimes behind it. This is the time shown by all well-regulated watches and chronometers.

Equation of Time. There is sometimes a difference of a quarter of an hour between this apparent and mean time. This difference is called the equation *of time*, and is given in Table IV at Greenwich noon for each day of the month, and must be applied to the apparent time according to the instructions given at the top of the column, in order to obtain the mean time. This equation of time found in Table IV must be corrected for the Greenwich time. In Table IV*a*, under the daily variation at the top and opposite the hour of Greenwich at the side, the number of seconds will be found to apply to the equation of time found in Table IV to obtain the correct equation of time.

The method of obtaining the apparent time at sea, and thence the mean time, is by observing the altitude of the sun, taken either in the forenoon or afternoon when it is rising or falling fastest, or when bearing nearly east or west, noting the time by watch at the same instant.

The preliminary steps in solving this problem will consist in finding the following data: the *correct Greenwich date* expressed astronomically, the *true altitude* of the sun, *latitude* of the place, and the *polar distance* of the sun.

The Greenwich date is found by comparing the watch with

the chronometer, which will give the time shown by the chronometer when the observation was taken; apply the error and rate of the chronometer and the Greenwich mean time is obtained.

The true altitude is found by correcting the observed altitude for semi-diameter, index correction, refraction, dip, and parallax in the same manner as explained for correcting the meridian altitude.

The latitude of the place is found by dead-reckoning from the last position to the time of observing the altitude. It is sometimes the practice to observe an altitude in the morning for time and delay working till noon, when the meridian altitude gives the latitude which is worked back by dead-reckoning to the time of taking the observation.

The polar distance is the distance of the sun from the north pole when the observation is taken in north latitude, and its distance from the south pole when taken in south latitude.

Take from Table III the declination corresponding to the Greenwich date, and multiply the difference for one hour by the Greenwich time, which apply as before explained to obtain the true declination.

As the declination is the distance of the sun from the equator and the equator is 90° from the poles, it follows that the declination subtracted from 90 if of the same name as the latitude, or added if of a contrary name, will give the polar distance.

Having thus found the correct altitude, latitude, and polar distance, the apparent time of observation may be found by the following method and the use of Table V. In this table, if the sine or cosine sought is marked at the top of the page, the title, hour A.M. or P.M., is also found at the top, and the contrary if the sine or cosine is marked at the bottom.

Add together the altitude, latitude, and polar distance and take half their sum; from this half sum subtract the altitude and note the remainder. Take from Table V the secant of the latitude, the cosecant of the polar distance (rejecting 10 in the index), the cosine of the half sum, and the sine of the remainder; add these together and take half the sum, which seek for in the column of sines, and opposite to it will be the corresponding apparent time.

Take from Table IV the equation of time corresponding to the Greenwich date, corrected for Greenwich time by Table

IV*a*, and apply it to this apparent time according to the directions at the top of the column, and we shall obtain the mean time of the observation. Take the difference between this and the Greenwich time, and the result is the longitude *east* when the Greenwich time is the least, and *west* if the Greenwich time is greater than the time of the place.

EXAMPLE.

On Nov. 9, 1889, in the forenoon, the observed altitude of the sun's lower limb was 22° 29′ 20″; height of the eye 17 feet; index correction + 2′ 45″; watch time of observation $8^h\ 51^m\ 57^s$ A.M.; slow of chronometer time $4^h\ 54^m\ 15^s$; chronometer correction $-\ 2^m\ 12^s$; with latitude by dead-reckoning 35° North. Find the longitude.

PREPARATION OF DATA.

W. Time	$8^h\ 51^m\ 57^s$ A.M.	Obs. Alt.	22° 29′ 20″
C.—W.	4 54 15	S. D.	+ 16 00
C. Time	1 46 12 P.M.	I. C.	+ 2 45
C. Corr.	− 2 12	Ref.	− 2 20
G. M. T.	1 44 00 P.M.	Dip	− 4 02
		Par.	+ 8
		True Alt.	22 41 51
Dec.	17° 00′ 00″ S.	Diff.	$1^h\ 43''$
Corr.	+ 1 13	G. M. T.	1.7
True Dec.	17 01 13 S.	Corr.	73.1
	90 00 00	or	+ 1′ 13″
Pol. Dist.	107 01 13		

SOLUTION.

Alt.	22° 41′ 51″		
Lat.	35 00 00	sec	0.08664
Pol. Dist.	107 01 13	cosec	0.01945
Sum	164 43 04		
Half Sum	82 21 32	cos	9.12374
Alt.	22 41 51		
Rem.	59 39 41	sin	9.93604
			2)19.16587
		sin	9.58293

Local App. Time $8^h\ 59^m\ 58^s$ A.M.
Equation of Time $-\ 16\ 01$

Local M. Time $8\ 43\ 57$ A.M.
Gr. M. Time $1\ 44\ 00$ P.M.

Diff. Time $5\ 00\ 03$
Longitude $75°\ 00'\ 45''$ W.

Equation of Time, Table IV, $-\ 16^m\ 02^s$
Daily Variation 6^s
Correction, Table IV*a*, $-\ 1$

Equation of Time $-\ 16\ 01$

About 8 A.M. April 3, 1888, in latitude 20° 45′ S. and east longitude, the observed altitude of the sun's lower limb was 24° 37′ 10″; index correction + 2′ 20″; height of the eye 19 feet; watch time of observation $7^h\ 57^m\ 07^s.5$; slow of chronometer time $5^h\ 57^m\ 24^s$; chronometer correction $-\ 3^m\ 38^s$. Find the longitude.

PREPARATION OF DATA.

W. Time $7^h\ 57^m\ 07^s.5$
C.—W. $5\ 57\ 24$

C. Time $1\ 54\ 31.5$
C. Corr. $-\ 3\ 38$

G. M. T. 3d 13 50 53.5

Obs. Alt. 24° 37′ 10″
S. D. + 16 00
I. C. + 2 20
Ref. − 2 66
Dip − 4 16
Par. + 0 08

True Alt. 24 49 16

Dec. 5° 35′ 00″ N.
Corr. + 13 06

True Dec. 5 48 06 N.
90 00 00

Pol. Dist. 95 48 06

Hr. Diff. 57″
G. M. T. 13.8 hrs.

786.6
Corr. + 13′ 06″.6

SOLUTION.

Alt. 24° 49′ 16″
Lat. 20 45 00 — sec 0.02913
Pol. Dist. 95 48 06 — cosec 0.00223

Sum 141 22 22

Half Sum	70	41	11
Alt.	24	49	16
Rem.	45	51	55

cos 9.51948

sin 9.85594

2)19.40678

sin 9.70339

Local App. Time $7^h\ 57^m\ 17^s$ A.M.
Equation of Time + 3 00

Local M. Time 8 00 17 A.M.
Gr. M. Time 1 50 53.5 A.M.

Diff. Time 6 09 23.5
Longitude 92° 20′ 33″ E.

Equation of Time, Table IV, $+\ 3^m\ 10^s$
Daily Variation 18^s.
Correction, Table IV*a*, − 10

Equation of Time + 3 00

About 8 A.M. Feb. 21, 1888, in latitude 24° 10′ N. and west longitude, the observed altitude of the sun's lower limb was 21° 44′ 10″; index correction − 2′ 10″; height of the eye 19 feet; watch time of observation $8^h\ 01^m\ 12^s$; slow of chronometer time $3^h\ 04^m\ 07^s$; chronometer correction $+\ 7^m\ 35^s$. Find the longitude.

PREPARATION OF DATA.

W. Time	8^h	01^m	12^s A.M.
C.—W.	3	04	07
C. Time	11	05	19 A.M.
C. Corr.	+	7	35
G. M. T.	22d	23	12	54
or			
21st	−		$0^h.79$

Obs. Alt.	21°	44′	10″
S. D.	+	16	00
I. C.	−	2	10
Ref.	−	2	25
Dip	−	4	16
Par.	+	0	08
True Alt.	21	51	27

Dec.	10°	38′	00″ S.
Corr.		+ 43	
True Dec.	10	38	43 S.
	90	00	00
Pol. Dist.	100	38	43

Hr. Diff. 54″
G. M. T. − 79

Corr. + 42.66

SOLUTION.

Alt.	21° 51′ 27″	
Lat.	24 10 00	sec 0.03983
Pol. Dist.	100 38 43	cosec 0.00754
Sum	146 40 10	
Half Sum	73 20 05	cos 9.45754
Alt.	21 51 27	
Rem.	51 28 38	sin 9.89340
		2)19.39831
Local App. Time	7h 59m 53s A.M.	sin 9.69915
Equation of Time	+ 13 53	
Local M. Time	8 13 46 A.M.	
Gr. M. Time	11 12 54 A.M.	
Diff. Time	2 59 08	
Longitude	44° 47′ 00″ W.	

Equation of Time, Table IV, + 13m 53s
Daily Variation 0s.
Correction, Table IV*a*, 0
Equation of Time + 13 53

On April 3, 1888, in the forenoon, in latitude 29° 42′ 30″ S. and east longitude, the observed altitude of the sun's lower limb was 22° 41′ 30″; index correction − 2′ 30″; height of the eye 24 feet; watch time of observation 8h 06m 20s.5; slow of chronometer time 8h 08m 14s; chronometer correction − 6m 19s. Find the longitude.

PREPARATION OF DATA.

W. Time	8h 06m 20s.5 A.M.	Obs. Alt.	22° 41′ 30″
C W.	8 08 14	S. D.	+ 16 00
C. Time	4 14 34.5	I. C.	− 2 30
C. Corr.	− 6 19	Ref.	− 2 19
		Dip	− 4 48
		Par.	+ 08
G. M. T.	2d 16 08 15.5	True Alt.	22 48 01
or			
3d − 7h.86.			

Dec.	5°	35′	00″ N.	Hr. Diff.	57″
Corr.	− 7	28		G. M. T.	− 7.86
True Dec.	5	27	32 N.	Corr.	448.02
	90	00	00		or
					− 7′ 28″
Pol. Dist.	95	27	32		

SOLUTION.

Alt.	22°	48′	01″		
Lat.	29	42	30	sec	0.06120
Pol. Dist.	95	27	32	cosec	0.00198
Sum	147	58	03		
Half Sum	73	59	01	cos	9.44077
Alt.	22	48	01		
Rem.	51	11	00	sin	9.89162
					2)19.39557
Local App. Time	8ʰ	00ᵐ	43ˢ A.M.	sin	9.69778
Equation Time	+ 3	15			
Local M. Time	8	03	58 A.M.		
Gr. M. Time	4	08	15.5 A.M.		
Diff. Time	3	55	42.5		
Longitude	58°	55′	37″ E.		

Equation of Time, Table IV, + 3ᵐ 10ˢ
Daily Variation 18ˢ.
Correction Table IV*a*, + 5
Equation of Time + 3ᵐ 15

CHAPTER VII.

A Sumner.

It has already been said the sun should be observed for time when bearing nearly east or west, for then the altitude cannot only be observed with more accuracy and the time noted more exactly when the sun is rising or falling the fast-

est, but the longitude can be found without the necessity of the latitude being accurately known; in fact an uncertainty of two or three degrees in the latitude would not make much difference in the time derived from the observation.

As the sun begins to move away from the east or west points the error in the latitude begins to affect the longitude more and more, until at north or south a very slight difference in the latitude makes a great difference in the longitude.

The sun can only pass the east or west points when its declination is of the same name as the latitude; but when they are of contrary names the sun cannot bear east or west, but will come nearer to those points at rising or setting, at which time the low altitude is too much affected by the excessive refraction. In either case clouds and other causes will often interfere to prevent the observation being taken at or near the proper bearing; hence it is plain the latitude should be accurately known.

Now it will often happen that a meridian altitude for latitude cannot be had for several days, while at the same time dead-reckoning must be relied upon to work the latitude up to the time of the observation, from which an error is sure to follow. It remains, then, to show what use can be made of the sun to find the position of the ship when the sun occupies a place neither east nor west nor on the meridian. This brings us now to the most important problem in navigation, and one which is universally used at sea, called "**a sumner.**"

This method consists in working the observation, when the latitude is uncertain, with two assumed latitudes, the one a little greater and the other a little less than the latitude we are supposed to be in, by which one observation for time enables us to find the bearing of land, and two observations, between which the sun has changed its bearing, will give us both the latitude and longitude provided the chronometer is right or its error and rate are known.

Circles of Equal Altitudes. At any given instant the sun is vertically above some point on the earth's surface. At this spot an observer with a sextant would find the true altitude of the sun's centre to be 90 degrees. If, however, the observer should shift his position away from the sun, its distance from his zenith would of course become greater and its altitude less. He would then be situated upon a small circle

the centre of which would be the spot under the sun. All persons on that circle would have the sun at an equal altitude. Finally, when he came to the horizon, all points on the circle would have the sun in the horizon. These circles of equal altitudes cut the various parallels of latitude and meridians at different angles. Near the east and west points the circles run up and down nearly with the meridians; so that if the observer were at the east or west points of the circle it would make little difference whether the latitude were exact or not, for there the longitude remains nearly the same for a long distance in latitude. Near the north and south points the circles run nearly east and west with the parallels of latitude; so that if he were at one of those points of the circle, a very slight difference in the latitude would make a great difference in the longitude. Hence it follows if an observer had a certain altitude we see that different latitudes would put him at different points of his circle of equal altitudes, and that these points would differ in longitude, at first slowly when near east or west, and then more rapidly as the point approached north or south.

Line of Position. As the circles are so large, compared with the difference between the latitudes which are used, this portion of the circle may be regarded as a straight line, which line is called a **line of position,** and *is always at right angles to the bearing of the sun.*

To obtain this line of position in actual practice, assume a latitude which is 10 to 30 minutes greater than that by dead-reckoning and a latitude 10 to 30 minutes less, and from each of these work out the observation for time. From the two resulting longitudes and the latitude of each, plot the positions on the chart and connect them by a straight line; we shall then have a line on which the ship is somewhere.

If this line runs parallel to the coast, its distance is approximately known, and the bearing of some known point on shore or a cast of the lead will give the position on the line. If the line on the chart be extended till it meets a point of land, it shows the bearing of that point. Although the exact distance of this point is unknown, yet we have only to sail on this line till the point is reached. Thus it is seen how with one observation the ship may be kept out of the danger whose bearing or distance is not exactly known.

If, after the sun has changed its bearing not less than three points,—but the nearer to eight points the better,—we should take another observation, it will give, by working in the same manner, a second line of position, which must cross the first one at some point, as they are each at right angles to the sun at the moment of observation. If the ship has not changed her position between the observations, the point of intersection of the two lines of position will be the position of the ship. But in practice the ship is very seldom stationary between the observations, and to find her position at the moment of the last one, lay off on the chart from the first line of position the course and distance made good between the two observations, and draw a parallel line to this first line of position; then the ship would be somewhere on the parallel line after having sailed a certain distance in a given direction. As the ship is also on the second line of position, its intersection with the parallel line will be the position of the ship at the moment of taking the second observation.

If the two lines of position do not intersect, the latitudes used were not far enough apart, and the lines must be prolonged till they do meet.

EXAMPLES.

On Nov. 9, 1889, in the forenoon, in latitude 34° 40′ N. by dead-reckoning, observed the altitude of the sun's lower limb 22° 29′ 20″; watch time of observation $8^h\ 51^m\ 57^s$ A.M., slow of chronometer time $4^h\ 54^m\ 15^s$; chronometer correction $-2^m\ 12^s$; height of the eye 17 feet; index correction $+2'\ 45'$. Find the line of position. Assume the latitudes 34° 10′ and 35° 10′ N.

PREPARATION OF DATA.

W. Time	$8^h\ 51^m\ 57^s$ A.M.	Obs. Alt.	22° 29′ 20″
C.—W.	4 54 15	S. D.	+16 00
C. Time	1 46 12 P.M.	I. C.	+ 2 45
C. Corr.	— 2 12	Ref.	— 2 20
Gr. M. T.	1 44 00 P.M.	Dip	— 4 02
Dec.	17° 00′ 00″ S.	Par.	+ 8
Corr.	+1 13	True Alt.	22 41 51
		Diff.	1 hr. 43″
		G. M. T.	1.7

True Dec.	17 01 13 S.	Corr. 73″.1
	90 00 00	or 1′ 13″
Pol. Dist.	107 01 13	

SOLUTION.

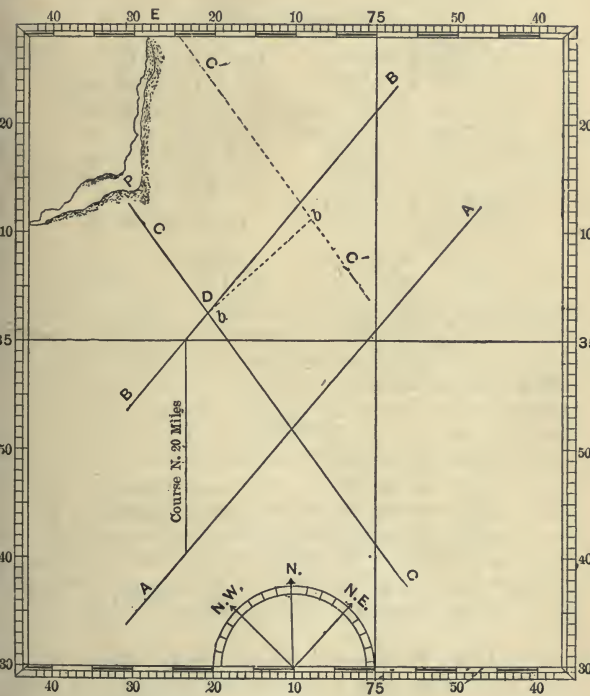
Alt.	22° 41′ 51″	
Lat.	34 10 00	sec 0.08228
Pol. Dist.	107 01 13	cosec 0.01945
Sum	163 53 04	
Half Sum	81 56 32	cos 9.14669
Alt.	22 41 51	sin 9.93417
Rem.	59 14 41	
		2)19.18259
		sin 9.59129

Alt.	22° 41′ 51″	
Lat.	35 10 00	sec 0.08752
P. D.	107 01 13	cosec 0.01945
Sum	164 53 04	
Half Sum	82 26 32	cos 9.11901
Alt.	22 41 51	
Rem.	59 44 41	sin 9.93641
		2)19.16239
		sin 9.58119

L. A. T.	8^h 56^m 16^s	L. A. T. 9^h 00^m 43^s
Eq. T.	— 16 01	Eq. T. — 16 01
L. M. T.	8 40 15 A.M.	L. M. T. 8 44 42 A.M.
G. M. T.	1 44 00 P.M.	G. M. T. 1 44 00 P.M.
Diff. T.	5 03 45	Diff. T. 4 59 18
or		or
Longitude	75° 56′ 15″ W.	Longitude 74° 49′ 30″ W.

Plot these two positions on the chart and connect them by a straight line which gives a line of position *AA*, and if the

observation was good and the chronometer right, the ship is on this line somewhere. Although the exact position on the line is not known, its direction affords an accurate knowledge of the least possible distance the ship can be from the point of danger *P*.



After determining the line of position by the forenoon observation, the ship was headed due north, but at noon a meridianaltitude for latitude could not be got, and the latitude by dead-reckoning being too uncertain, another observation was taken about 4 P.M., the ship having made good 20 miles in the interval. The observed altitude of the sun's lower limb was 17° 44′ 10″; watch time of observation $4^h\ 04^m\ 53^s$ P.M., slow of

chronometer time $4^h\ 12^m\ 20^s$; chronometer correction $-\ 2^m\ 12^s$; height of the eye 17 feet; index correction $+\ 2'\ 45''$. Find the second line of position and the position of the ship. The latitude by dead-reckoning being 35° N., assume the latitudes 34° 30′ and 35° 30′ N.

PREPARATION OF DATA.

W. Time	$4^h\ 04^m\ 53^s$	Obs. Alt.	17° 44′ 10″
C.—W.	4 12 20	S. D.	+ 16 00
		I. C.	+ 2 45
C. Time	8 17 13 P.M.	Ref.	− 3 01
C. Corr.	− 2 12	Dip	− 4 02
		Par.	+ ·8
Gr. M. T.	8 15 01 P.M.		
		Tr. Alt.	17 56 00
Dec.	17° 00′ 00″ S.	Diff.	1 hr. 43″
Corr.	+ 6 54	G. M. T.	8 25
True Dec.	17 06 54 S.	Corr.	354″.75
	90 00 00		+ 6′ 54″
Pol. Dist.	107 06 54		

SOLUTION.

Alt.	17° 56′ 00″		
Lat.	34 30 00	sec	0.08401
P. D.	107 06 54	cosec	0.01968
Sum	159 32 54		
Half Sum	79 46 27	cos	9.24927
Alt.	17 56 00		
Rem.	61 50 27	sin	9.94529
			2)19.29825
		sin	9.64912
Alt.	17° 56′ 00″		
Lat.	35 30 00	sec	0.08931
P. D.	107 06 54	cosec	0.01968
Sum	160 32 54		

Half Sum	80	16	27	cos	9.22737
Alt.	17	56	00		
Rem.	62	20	27	sin	9.94730
					2)19.28366
				sin	9.64183
L. A. T.	3^h	31^m	47^s	L. A. T.	3^h 28^m 00^s
Eq. T.		−16	01	Eq. T.	−16 01
L. M. T.	3	15	46 P.M.	L. M. T.	3 11 59 P.M.
G. M. T.	8	15	01 P.M.	G. M. T.	8 15 01 P.M.
Diff. T.	4	59	15	Diff. T.	5 03 02
or				or	
Longitude	74°	48′	45″ W.	Longitude	75° 45′ 30″ W.

From any point on the line of position *AA*, set off the true course north, and the distance 20 miles made good in the interval, and through the spot draw the parallel line *BB*. Then plot the two positions by the P.M. observation on the chart, and connect them by a straight line which will give a second line of position *CC*. The point *D* where it cuts the parallel line *BB* will be the position of the ship at the moment of the second observation.

Had there been no other line of position, *CC* prolonged would give the bearing of the point of land or danger *P*; and though its distance would not be accurately known, the soundings might give it: hence the danger could be avoided by shaping a course in a direction away from the line of position.

Should it be intended to dodge the point of land and make a port *E* on the other side, draw a parallel line *C′C′* to *CC* through *E*, and with the dividers measure the shortest distance *bb* between *CC* and *C′C′*; run that distance on a course perpendicular to *CC*; then by changing the course in the direction of *C′C′* the vessel will make the port *E* right ahead.

Had it been possible to obtain a meridian altitude for latitude, we could have laid off from the first line of position the course and distance made good from the time of observation to noon, and then drawn a parallel to *AA*. The spot where

the noon latitude cut the parallel would have been the position of the ship at noon.

It will be seen by an inspection of Table V that the cosine of 90 degrees and the sine of zero degrees are indeterminate; hence the nearer the half sum approaches 90 degrees or the remainder zero, the more indeterminate or uncertain the longitude obtained will be.

This will occur when the sun is near the meridian. Should the half sum exceed 180 degrees, or be less than the latitude, the assumed latitudes will be beyond the circle of equal altitudes, and other latitudes must be taken nearer the one that will give a resulting longitude.

CHAPTER VIII.

Compass Adjustment.

In a wooden vessel the deviations of the compass are usually so small that the compass can be easily corrected for all practical purposes; but in iron ships the deviations are not only very large, but they are so irregular that the vessel cannot be safely navigated unless the compass is what is termed *adjusted*. To understand this it is necessary to consider the elementary laws of magnetism.

The Earth a Magnet. A magnet has two poles of dissimilar nature and equal strength, separated by a neutral line over which neither pole has any influence. The earth may be considered as an immense magnet, having two north and two south magnetic poles. The strongest of these magnetic poles lies, the one in about latitude 70 degrees north, longitude 95 degrees west, and the other in about latitude 70 degrees south, longitude 145 degrees east. These two poles are of different polarities, and are denominated the north and south magnetic poles of the earth.

Magnetic Equator. The neutral line separating the two polarities, called the Magnetic Equator, is an irregular curve running round the earth not far from the earth's equator, crossing it in two places—one near the west coast of Africa in the Atlantic Ocean, the other nearly in the middle of the Pacific Ocean.

Poles of the Magnet. If a magnet be freely suspended by a thread, one end will point nearly to the north pole, the other to the south pole, of the earth. The end of the magnet pointing to the north is called its north pole, and the end pointing to the south is called its south pole.

Attraction and Repulsion of the Poles. If we take two magnets and present the north pole of the one to the north pole of the other, they will repel each other; but if the north pole of the one be placed near the south pole of the other they will attract each other: like poles repel and unlike poles attract each other.

Induced Magnetism. If we take a piece of soft iron and place it near the north pole of a magnet, the iron will be attracted by the magnet; the same effect will follow if the iron be placed near the south pole. This effect is produced by a temporary communication of magnetism to the soft iron by the magnet. It is called *induction*, and the pieces of soft iron thus magnetized are called *induced magnets*, to distinguish them from permanent magnets. Before any pole of a magnet can attract iron, it must first induce an opposite pole in the part of iron held nearest it. It is not necessary that the magnet and a piece of iron should be actually in contact to cause induction.

Influence of the Earth's Magnetism. The earth as a magnet has the power of inducing magnetism in bars of iron exposed to its influence in the same manner as other magnets.

Magnetic Dip. Near the magnetic equator a freely suspended magnet will remain in a horizontal position; but if carried northward towards the magnetic pole of the earth, the north end will gradually point downward until at the magnetic pole the magnet will become vertical. In the same manner, if the magnet be carried into the southern hemisphere the south end will gradually point downward, until at the magnetic pole the magnet will become vertical. This inclination of the magnet at any place is called the *dip* at that place.

The Earth's Line of Force is the direction which a freely suspended needle takes, the needle being horizontal at the magnetic equator and vertical at the magnetic poles. The line of force at any place is in the line of dip at that place, and is the most favorable position in which an iron bar can be placed to receive induced magnetism from the earth. A soft iron bar placed lengthwise in the line of force or held hori-

zontally in a north and south direction receives induced magnetism instantly, but parts with it quickly if it be held in an east and west direction at right angles to the magnetic meridian. Hard iron requires a longer period to receive magnetism by induction, and does not part with it so soon; it may even retain a part of its magnetism permanently.

Effect of Vertical Iron. In north magnetic latitude the upper end of vertical soft iron will attract the north pole of a magnetic needle held near it; on the other hand, in south magnetic latitude the upper end of vertical iron will attract the south pole of the needle, and repel the pole of the needle it had previously attracted. On the magnetic equator vertical soft iron has no effect because its position is at right angles to the line of force.

Effect of Horizontal Iron. A horizontal bar of soft iron at the magnetic poles has no magnetism, since there it is at right angles to the line of force. When taken, however, into low latitudes it gradually becomes magnetic if kept pointing towards the magnetic pole, and has the greatest power in the vicinity of the magnetic equator.

An Iron Ship a Magnet. Every iron ship is a magnet, the character of the magnetism and the position of the poles depending upon the value of the dip at the place of building and the direction in which the keel lay during the construction of the ship. The magnetic intensity of the vertical soft iron, such as the rudder-post, will remain the same, no matter what may be the direction of the ship's head; but its disturbing effect on the compass depends upon its position relative to the needle, being greatest when at right angles to the direction of the needle's length and ceasing when in line with it; whereas horizontal iron on board ship has a varying action on the compass, depending on the direction of the ship's head as well as the position of its poles relative to the compass needle.

Subpermanent Magnetism. After launching and reversal of the ship's head the magnetism undergoes rapid diminution; but in no case does it depart entirely. That which is left is called *subpermanent*. It is evident that the position of the poles of the ship's subpermanent magnetism must depend upon the direction of her head when building, and upon the dip at the part of the world in which she was built. If, for example, a ship were built with her head north

magnetic in north latitude where the dip is about 60 degrees, her magnetic condition would be shown in Fig. 1.

The line marked *dip* is the direction of the earth's lines of magnetic force. The line marked *neutral* is the line of no deviation, and runs at right angles to the dip. The shaded portion of the ship possesses south polarity, attracting the

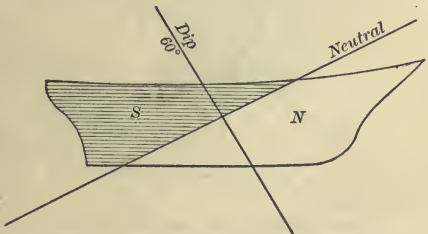


Fig. 1.—Head North while Building.

north pole of the compass needle ; the white portion below the neutral line possesses north polarity, repelling the north pole of a compass needle. Hence, if a compass be placed outside of and near the ship, above the line of no deviation, the north pole of the compass needle will be attracted ; if it be placed below that line, the north pole will be repelled and the south pole attracted.

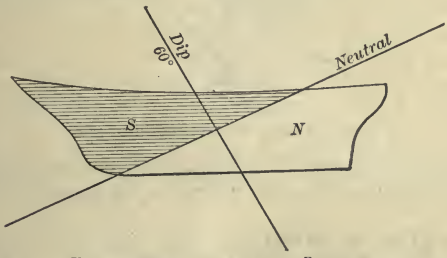


Fig 2.—Head South while Building.

If the ship had been built with her head south, the condition would be as in Fig. 2.

In this case the after part of the ship possesses north polarity, and the forward part possesses south polarity.

If the ship's head had been west while building, her magnetical conditions would be shown in Fig. 3.

The starboard side below the neutral line would repel the north pole of a compass needle, while the port side above the neutral line would attract it.

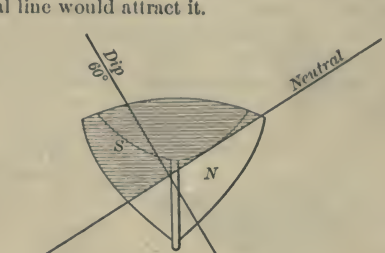


FIG. 3.—HEAD WEST WHILE BUILDING.

With the head east while building, the magnetical conditions would be the reverse, as in Fig. 4.

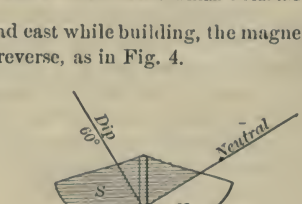


FIG. 4.—HEAD EAST WHILE BUILDING.

If the ship were built in south magnetic latitude, the shaded part showing south polarity lies below the neutral line, as in Fig. 5.

Two Kinds of Deviations. The error produced on the compass by the magnetism of an iron ship is of two descriptions, known as *semicircular* and *quadrantal* deviations. The semicircular is so called from being easterly in one semicircle and westerly in the other, as the ship's head moves round a complete circle. The quadrantal deviation is so called from its being easterly and westerly alternately in the four quadrants as the ship's head moves around a complete circle.

Semicircular Deviation is caused by the subpermanent magnetism in the ship and by the induced magnetism in vertical iron. There is little or no semicircular deviation from subpermanent magnetism with a ship's head on or near the points of the compass to which her head and stern were directed while building; and it is greatest on the points that

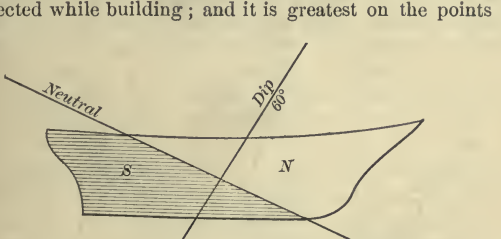


FIG. 5.—IN SOUTH MAGNETIC LATITUDE.

were nearly abeam of the ship while building. It changes as the ship changes her magnetic latitude, and that part of it which is caused by the induced magnetism of vertical iron disappears when a ship is near the magnetic equator, and is reversed when a ship passes into south magnetic latitude.

To illustrate the way in which the subpermanent magnetism and the induced magnetism of vertical iron acts upon the compass to produce semicircular deviation, let it be supposed that the whole of the *south* polarity of the above magnetism is concentrated in the point *A*, Fig. 6, on the port quarter of a ship built with her head NW.; this south pole will attract the north end of a compass needle and repel the south end.

In Fig. 6, the ship is supposed to be swung round, the compass beginning at the NW. point. The small circles represent the compass; the thick lines, *n.s.*, the compass needle; the dotted line, *N.S.*, the magnetic meridian or the direction of the needle when free from deviation. Beginning at the NW., and noting the position of *A*, it will be observed that there can be no semicircular deviation with the ship's head in that direction, because the attractive force of the ship's magnetism at the point *A* is in line with the compass needle *n.s.* As the ship's head swings round towards the west the

relative positions of the point *A* and the compass needle will alter, and *A* will exert forces upon the needle, causing it to deviate to the right from *N.* to *n.*, shown in the figure at west.

The easterly deviation will increase until the ship's head swings to near SW., where it attains its maximum, or greatest, amount. After passing the point of greatest deviation, it gradually decreases until the ship's head reaches SE., the

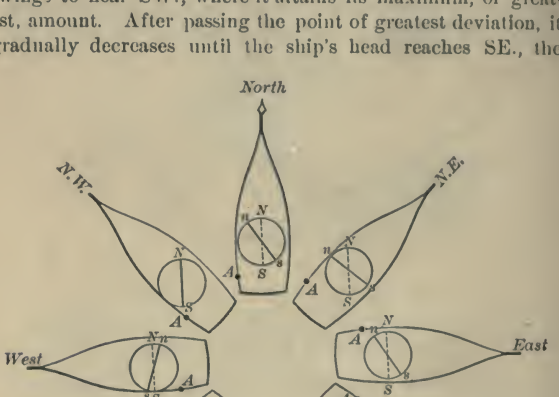


FIG. 6.

opposite direction to that in which her head was built, where it is again nothing. As the ship's head comes towards the east the needle will gradually be drawn to the left hand until the westerly direction becomes greatest at near NE., and will then decrease until the head reaches NW., the point of no deviation. From this it will be seen that in the semicircle from NW. round by west to SE. the deviation is easterly, while in the semicircle from SE. round by east to NW. the deviation is westerly.

No two ships are alike in their influence on the compass, nor

will the ship's magnetism have the same effect on two compasses placed in different parts of the deck. However, the same principle of correction will apply to all; that is, the permanent portion of the ship's magnetism, which causes semicircular deviation, is compensated by steel magnets, whose magnetism is likewise permanent; and that part due to induction in vertical iron, which comes and goes with change of latitude, and likewise causes semicircular deviation, is compensated by vertical tubes of ordinary wrought iron. These vertical tubes become magnetized by induction from the earth, the amount and kind of magnetism varying with the latitude, as in the vertical iron.

Quadrantal Deviation is caused by the induced magnetism of horizontal soft iron and is the same for all latitudes. To illustrate the way in which horizontal soft iron produces quadrantal deviation, let the whole of the horizontal soft iron in a ship be represented by the soft-iron bar *B* in Fig. 7.

Beginning at the north, it will be observed that the bar *B* is parallel with its magnetic meridian, and will therefore be an induced magnet while it is in or near that position; as it is in line with the compass needle *n.s.*, it cannot exert any deviating power upon the needle. As the ship's head swings towards the NW. the relative positions of the bar *B* and the needle *n.s.* are altered, and the south end of the bar draws the north pole of the needle to the left, from *N.* to *n*. As the ship's head approaches the west the bar *B* loses its force, and at west it is at right angles to the magnetic meridian, and ceases to exert any influence on the compass.

The ship's head now swings towards the SW., and the bar *B* as it turns towards the south pole again becomes an induced magnet; its after end being a north pole, draws the south pole of the compass needle from *S.* to *s*. When the ship's head reaches south there is no deviation again, because the bar *B* is in line with the needle.

As her head swings towards the SE. the needle is drawn from *S.* to *s.*, causing westerly deviation. At east there is no deviation, for the same reason that there was none at west. After passing east, the after end of *B* becomes a south pole and draws the north pole of the needle to the right; continuing on to the north, the quadrantal deviation decreases until it becomes nothing at north.

From this it will be seen that *B* produces easterly deviation in the NE. and SW. quadrants, and westerly deviations in the NW. and SE. quadrants. This deviation is compensated by hollow spheres of soft iron or boxes of wrought-iron chain placed athwartships and so that their centres may be as nearly as possible on the same level as the compass-needle.

Adjustment for Semicircular Deviation.—Choose a fine day and get the ship on an even keel. On the deck draw two chalk-lines, one fore and aft and the other athwartships, their

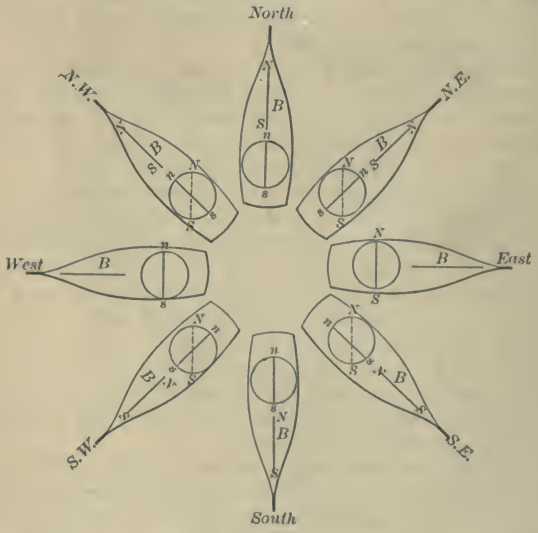


Fig. 7.

intersection being directly under the centre of the compass card. Let the ship's head be swung to the north or south, correct magnetic, and when steady at one of these points, observe whether there is any deviation ; if there is any, lay one of the permanent compensating magnets on the deck athwartships with its centre exactly on the fore-and-aft line ; move it to or from the foot of the binnacle until the compass points correctly. If the compass deviates to the left the north end of the magnet must be placed to the left, and conversely. If one

magnet is not sufficient to correct the deviation, apply another on the opposite side of the compass with similar poles in the same direction.

After the compass has been made to point correctly at either the north or south points, swing the ship's head to the east or west, correct magnetic, and steady on one of these points. Should there be any deviation now, it must be corrected partly by fore-and-aft magnets, and partly by an upright iron tube. How much is to be corrected by one and how much by the other is not easily ascertained, but the following will suffice: Place a permanent magnet on the deck fore and aft, either to starboard or port of the compass, with its centre upon the athwartship line; move it slowly towards the binnacle till half the deviation is corrected. Next place the upright tube forward or abaft of the binnacle at such a distance as will correct the remaining half of the deviation, when it may be securely bolted down to the deck. If the deviation could be obtained on the east and west points when the ship is on the magnetic equator, and afterwards sail to a high latitude, where the deviation is again determined on those points, the difference will be the amount to be corrected by the vertical tubes. If, while on a cruise, it becomes necessary to readjust, the original positions of the magnets should always be marked, in order that the magnets may be replaced when required.

Adjustment for Quadrantal Deviation. Put the ship's head on any of the four magnetic points NE., SE., SW., or N.W.; if there is any deviation, place a hollow cast-iron sphere on each side of the compass and move them nearer to or farther from it till the compass points correctly, being careful to have the centres of the spheres level with the needle, and each at same distance from centre of compass, and not to place the inner edge of the spheres any nearer the compass than the length of the needle. When this adjustment is properly made, it ought to remain perfect for all latitudes.

Heeling Error. The compass has now been adjusted with the ship on an even keel, but as the ship begins to heel over, either to starboard or port, the deviation is generally altered; what was before horizontal iron inclines to a vertical position, receiving induced magnetism from the earth. The position of the vertical iron is also changed, producing a corresponding change of deviation.

This heeling error changes as the ship changes her latitude, and is greatest when the ship's head is north or south, and least when east or west by compass. The usual effect of the heeling error in north latitude, with a list on northerly courses, is to cause the ship to deviate from her apparent course in a direction towards the high side of the ship, and on southerly courses to deviate from her apparent course in a direction towards the lower side of the ship.

Adjustment for Heeling Error. The heeling error is corrected by a vertical permanent magnet placed in a suitable case in the vertical axis of the binnacle directly under the compass-needle, the case capable of being raised or lowered as required. After the horizontal correction of the compass with the ship upright, could the vessel be heeled, say, 10 degrees, the difference between the compass reading, ship upright and ship heeled, will give the deviation due to heel for the course steered at that time. It would be preferable to steady the ship's head at north or south magnetic. To correct this deviation insert the heeling magnet in the case and raise or lower it until the compass reads as on an even keel, when secure the magnet. Generally the north pole of the magnet should be uppermost in north latitudes, but the proper end is very easily determined on trial. As heeling error varies in change of latitude, this correction should be frequently readjusted, and the heeling magnet reversed end for end in changing hemispheres.

The compass by being adjusted is neither rendered absolutely correct nor insensible to change, but the error of the compass is reduced to within more manageable bounds. As above described, the compass when adjusted will appear as in Figs. 8 and 9.

Retentive Magnetism. There is one other part of the ship's magnetism, known as Retentive Magnetism, that plays a very important part in the deviation of the compass. This retentive magnetism is the temporary magnetism of the ship acquired by induction from the earth when the ship's head has been in one direction for a long time, either in dock or on a voyage. This magnetism is lost in the course of time by altering the deviation of the ship's head. The immediate effect of retentive magnetism is to cause the compass, on a change of the ship's course, to deviate in the direction of the last

course. In other words, if an iron ship has maintained a constant southerly course for some days, and then changes to the westward, the needle will be drawn to the left by retentive magnetism; that is, the deviation will be increased if westerly and diminished if easterly, causing the ship to steer to the southward of her intended course. It is impossible to

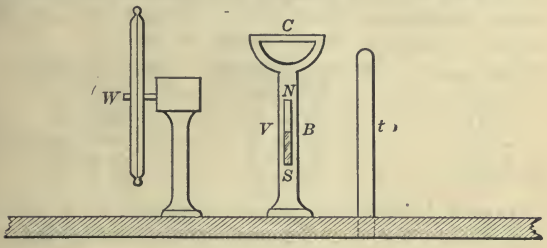


Fig. 8.—Side Plan.

adjust the compass for retentive magnetism, hence its effect must be taken into account upon a change of course. If the vessel has maintained the same course for long time, before steering a new course the ship should be turned about a circle

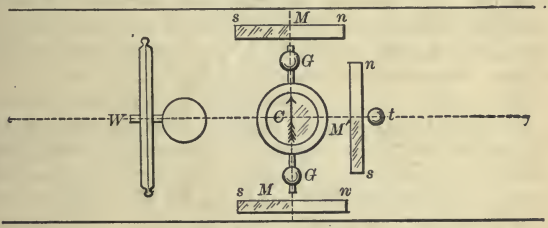


Fig. 9.—Deck Plan.

and for a time steadied upon the point opposite to the original course.

In conclusion, the changes in the ship's magnetism, due to collisions, buffeting with the waves, tremor of the screw, retentive magnetism, and the effect on the compass of magnetic bottom in certain localities, point out the necessity of a careful watch on the compass at all times. A table of deviations is as necessary after adjustment as before, and the error of the compass should be frequently found and the table corrected.

CHAPTER IX.

General Examples for Exercise.

Example 1. In swinging ship in an open harbor (page 9, Case II) the following bearings were observed of a distant object; find the error of the compass in each case, the true bearing of the distant object being N. 41° 12′ W.

Ship's Head.	Bearing of Object by Compass.	Error of Compass.
N.	N. 22° 42′ W.	18° 30′ W.
NE.	N. 31° 00′ W.	10° 12′ W.
E.	N. 31° 48′ W.	9° 24′ W.
SE.	N. 25° 30′ W.	15° 42′ W.
S.	N. 18° 00′ W.	23° 12′ W.

Example 2. In swinging ship in a closed harbor (page 9, Case III) the following bearings were observed; find the deviation in each case. Bearings of the ship compass from the shore, N. ¼ W., N. by E. ¼ E., N. ¾ W. Corresponding bearings of shore compass from the ship, S. by E., SSW. ¼ W., S. ¼ W. *Ans.* ¾ pt. E., 1 pt. W., 1 pt. W.

Example 3. In swinging ship in a closed harbor (page 9, Case III) the following bearings were observed. Find the deviation in each case. Bearings of the ship compass from the shore, N. ¼ E., SW. by W., W. ¼ N. Corresponding bearings of shore compass from the ship, S. ¼ E., NE. ¼ E., E. ¼ N.

Ans. ¼ pt. E., ¼ pt. E., ¾ pt. E.

Example 4. The ship on the way down the channel was stopped and the following bearings of two objects in line were taken for compass error (page 24). The true bearings of the objects in line on the chart was N. 12° 30′ W. Find the error of the compass in each case.

Ship' Head.	The Line of Compass.	Error of Compass.
N. 6° E.	N. 0° 15′ W.	12° 15′ W.
N. 35° E.	N. 15° 30′ W.	3° 00′ E.
N. 65° E.	N. 20° 00 W.	7° 30′ E.
S. 60° E.	N. 8° 30′ W.	4° 00′ W.
S. 50° E.	N. 6° 00′ W.	6° 30′ W.

Example 5. The bearing of a distant object by the ship's compass was N. 50° W., with the ship's head N. 78° 45′ E. What was the magnetic bearing of the distant object?

Ans. N. 42° 30′ W.

EXAMPLE 6. The compass course is ENE. or N. 67° 30′ E., and the deviation is 7° 20′ E. What is the magnetic course?

Ans. N. 74° 50′ E.

EXAMPLE 7. The compass course is SSW. and the deviation is 5° 20′ W. What is the magnetic course?

Ans. S. 17° 10′ W.

EXAMPLE 8. The compass course is NE., deviation 8° E., variation 9° 30′ E. What are the magnetic and true courses?

Ans. Magnetic, N. 53° E.; true, N. 62° 30′ E.

EXAMPLE 9. The compass course is NNE., deviation 5° 40′ E., variation 10° W. What are the magnetic and true courses?

Ans. Magnetic, N. 28° 10′ E.; true, N. 18° 10′ E.

EXAMPLE 10. The compass course is NW. by W.; wind NNE.; deviation 5° 40′ W.; leeway 1 pt.; and variation 8° 45′ E. What are the magnetic and true courses?

Ans. Magnetic, N. 73° 10′ W.; true, N. 64° 25′ W.

EXAMPLE 11. The true course is WNW.; variation 6° 40′ E.; deviation 4° 10′ W.; wind N.; leeway 2 pts. What are the magnetic and compass courses?

Ans. Magnetic, N. 74° 10′ W.; compass, N. 47° 30′ W.

EXAMPLE 12. The true course is N. 26° 05′ E.; variation 7° 35′ W.; wind E.; leeway 1 pt. What is magnetic course? Find from table what deviation to apply and then find the compass course.

Ans. Magnetic, N. 33° 40′ E.; deviation 6° 09′ E.; compass N. 38° 46′ E.

EXAMPLE 13. In latitude 50° 13′ N. the ship sailed the following true courses and distances. Find the course and distance made good. WSW. 51 miles; W. by N. 35 miles; S. by E. 45 miles; SW. by W. 55 miles; SSE. 41 miles.

Ans. S. 39° W.; distance 162 miles.

EXAMPLE 14. In latitude 49° 58′ N. and longitude 5° 12′ W. the ship sailed the following courses (true) and distances. Find the course and distance made good. Latitude and longitude in S. 3 pts. W. 14 miles; S. 7 pts. W. 31 miles; S. 2¼ pts. W. 20 miles; S. 1½ pts. W. 20 miles; N. 3¼ pts. W. 26 miles; N. ¼ pt. E. 28 miles; S. 3¾ pts. W. 24 miles; N. 5 pts. W. 8 miles.

Ans. S. 78° 36′ W; distance 93 miles; latitude 49° 40′ N.; longitude 7° 33′ W.

EXAMPLE 15. The sun and its image were brought together (page 38) when the following readings on the sextant were

made. Find the index error. On the arc 33′ 10″; off the arc 31′ 10″. *Ans.* — 1′ 00″.

EXAMPLE 16. The sun and its image were brought together when the following readings on the sextant were made. Find the index error. On the arc 30′ 10″; off the arc 35′ 00″.

Ans. + 2′ 25″.

EXAMPLE 17. Given the following readings of the sextant, find the index error. On the arc 35′ 50″, 36′ 00″, and 36′ 10″; off the arc 27′ 20″, 27′ 30″, and 27′ 40″. *Ans.* — 4′ 15″.

EXAMPLE 18. The difference of longitude between two places is 98° 41′ 36″. What is the difference in time?

Ans. 6 hrs. 34 min. 46.4 sec.

EXAMPLE 19. The difference of longitude between two places is 60° 30′ 24″. What is the difference in time?

Ans. 4 hrs. 2 min. 1.6 sec.

EXAMPLE 20. One place is in longitude 125° 16′ 24″ E., another in 143° 18′ 36″ W. Find the difference in time between the two places. *Ans.* 6 hrs. 5 min. 40 sec.

EXAMPLE 21. The difference of longitude between two places is 73° 1′ 00′. What is the difference in time?

Ans. 4 hrs. 52 m. 4 sec.

EXAMPLE 22. The difference in time between two places is 6 hrs. 0 min. 19.26 sec. What is the difference in longitude?

Ans. 90° 4′ 48″.9.

EXAMPLE 23. When it is 2 hrs. 10 min. 15 sec. in the afternoon at A. it is six o'clock in the afternoon at B. What is the difference of longitude? *Ans.* 57° 26′ 15″.

EXAMPLE 24. When it is 10 hrs. 30 min. A.M. at a place in west longitude, it is 5 hrs. 9 min. 10 sec. P.M. at one in east longitude. What number of degrees of longitude are the two places apart? *Ans.* 99° 47′ 30″.

EXAMPLE 25. It is May 12th, 2 hrs. at ship, in longitude 17° 25′ 30″ E.; the chronometer shows 50 min. past 12. What is the Greenwich date?

Ans. May 12th, 0 hrs. 50 min. 18 sec.

EXAMPLE 26. It is May 12th in longitude 120° 13′ 14″ E.; the chronometer shows 9 hrs. 20 min. 10 sec. A.M. What is the time at the ship P.M.?

Ans. May 12th, 5 hrs. 21 min. 2.9 sec.

EXAMPLE 27. It is May 12th in longitude 120° 13′ 14″ W.;

the chronometer shows 9 hrs. 20 m. 10 sec. A.M. What is the time at ship A.M.? *Ans.* May 11th, 13 hrs. 19 min. 17.1 sec.

EXAMPLE 28. Sept. 4th, 1890, at 5 hrs. 49 m. P.M., nearly, at ship, in longitude by D. R. 147° 18′ W., the chronometer showed 3 hrs. 35 min. 18 sec., and its error was 4 min. 18 sec. slow. What is the Greenwich date?

Ans. Sept. 4th, 15 hrs. 39 min. 36 sec.

EXAMPLE 29. June 10th, 1890, at 10 hrs. 18 min. 4 sec. A.M., nearly, at ship in longitude 47° 18′ 15″ E., the chronometer, which was fast 10 min. 14 sec. on April 15th and gaining daily 2.5 sec., showed 7 hrs. 21 min. 20 sec. What is the correct Greenwich date? *Ans.* June 9th, 19 hrs. 8 min. 48.5 sec.

EXAMPLE 30. Aug. 31st, about 8 A.M., the chronometer showed 0 hrs. 5 min. 30 sec., in longitude 61° 10′ 30″ W., the error of the chronometer 1 min. 55 sec. slow. Find the correct Greenwich time and date.

Ans. 0 hrs. 7 min. 25 sec.; August 31st.

EXAMPLE 31. At noon in latitude 30° S. a watch was set right to mean time at ship, and by the following noon the ship sailed SW. true distance 120 miles. What is the error of watch on mean time at ship? *Ans.* 6 min. 32 sec. fast.

EXAMPLE 32. At 8 P.M. a watch is exactly right for mean time at ship; by 8 A.M. on the following morning the ship changed her longitude 72 miles to the eastward of her former position. How much must the watch be altered to set it to mean time at ship? *Ans.* Set ahead 4 min. 48 sec.

EXAMPLE 33. Jan. 17th, 1890, in longitude 59′ 40′ E., the sun on the meridian. Find the declination.

Ans. 20° 43′ 42″ S.

EXAMPLE 34. Jan. 5th, 1890, at 7 hrs. 40 min. 30 sec. P.M., in longitude 48° W. Find the declination.

Ans. 22° 31′ 55″.2 S.

EXAMPLE 35. July 23d, 1890, at 8 hrs. 20 min. 40 sec. A.M. in longitude 104° 12′ E. Find the declination.

Ans. 20° 08′ 18″.3 N.

EXAMPLE 36. Sept. 20th, 1890, at 8 hrs. 4 min. A.M., in longitude 77° 13′ W. Find the declination.

Ans. 0° 59′ 49″.6 N.

EXAMPLE 37. Feb. 14th, 1890, at 5 h. 30 m. 40 sec. P.M., in longitude 41° 03′ E. Find the declination.

Ans. 12° 52′ 39″ S.

EXAMPLE 38. Dec. 24th, 1890, the Greenwich mean time is 17 h. 44 m. Find the equation of time. *Ans.* 0 m. 19 sec.

EXAMPLE 39. May 24th, 1890, at 4 h. 35 m. P.M., in longitude 91° 30′ E. Find the equation of time.

Ans. 3 m. 23 sec.

EXAMPLE 40. March 3d, 1890, at 8 h. 20 m. A.M., in longitude 169° 40′ W. Find the equation of time.

Ans. 12 m. 01 sec.

EXAMPLE 41. Oct. 11th, 1890, in longitude 159° 30′ E. the local mean time is 8 h. 3 m. 17 sec. A.M. What is the local apparent time? *Ans.* Oct. 10, 20 h. 16 m. 21 sec.

EXAMPLE 42. April 23d, 1890, A.M., in longitude 125° 28′ 15″ W., the time by chronometer is 5 h. 27 m. 12 sec.; chronometer correction — 8 m. 12 sec. Find the local apparent time.

Ans. April 22d, 20 h. 58 m. 56 sec.

EXAMPLE 43. Oct. 3d, 1888, in longitude 67° 30′ W. the observed meridian altitude of the sun's lower limb was 40° 23′ 50″ bearing north; index error + 1′ 30″; height of the eye 18 feet. Find the latitude. *Ans.* 53° 42′ 14″ S.

EXAMPLE 44. March 8th, 1890, in longitude 15° 15′ E. the observed meridian altitude of the sun's lower limb was 83° 58′ 16″ bearing north; index error + 3′ 15″; height of the eye 22 feet. Find the latitude. *Ans.* 10° 36′ 08″ S.

EXAMPLE 45. May 1st, 1890, in longitude 30° 30′ W. the observed meridian altitude of the sun's lower limb was 84° 59′ bearing S.; index error — 2′ 20″; height of the eye 18 feet. Find the latitude. *Ans.* 20° 01′ 03″ N.

EXAMPLE 46. July 10th, 1890, in longitude 100° E., the observed meridian altitude of the sun's lower limb was 44° 43′ 26″ bearing N.; index error 0; height of the eye 20 feet. Find the latitude. *Ans.* 22° 49′ 43″ S.

EXAMPLE 47. Sept. 23d, 1890, in longitude 45° W., the observed meridian altitude of the sun's lower limb was 47° 10′ 30″ bearing S.; index error — 2′ 40″; height of the eye 18 feet. Find the latitude. *Ans.* 42° 30′ 13″ N.

EXAMPLE 48. About 8 A.M., Sept. 30th, 1890, in latitude 30° 10′ N. and west longitude, the observed altitude of the sun's lower limb was 29° 51′ 50″; index error + 2′ 10″; height of the eye 18 feet; watch time of observation 8 h. 20 m.; slow of chronometer time 1 h. 24 m. 44 sec.

Chronometer correction on Sept. 20th was + 1 h. 15 m. 0 sec., with a losing rate of 4.5 sec. Find the longitude.

Ans. 40° 05′ 30″ W.

EXAMPLE 49. April 23d, A.M., 1890, in latitude 44° 59′ S. and west longitude, the observed altitude of the sun's lower limb was 19° 9′; index error + 1′ 58″; height of the eye 14 feet. The time by chronometer 5 h. 27 m. 12 sec.; chronometer correction — 8 m. 12 sec. Find the longitude.

Ans. 125° 23′ 45″ W.

EXAMPLE 50. Jan. 20th, 1890, P.M., in latitude 50° 42′ S. and east longitude, the observed altitude of the sun's lower limb was 17° 10′; index correction — 2′ 13″; height of the eye 18 feet; watch time of observation 6 h. 46 m. 28 sec.; slow of chronometer time 5 h. 36 m. 15 sec.; chronometer correction + 29 sec. Find the longitude. *Ans.* 96° 06′ E.

EXAMPLE 51. An altitude of the sun was taken one forenoon and worked out with assumed latitudes of 35° 30′ N. and 35° 50′ N., respectively. The first gave a longitude of 14° 24′ W. and the second of 14° 05′ W. What is the direction of the line of position on the chart? *Ans.* N. 38° E.

EXAMPLE 52. An observation taken one forenoon and worked with assumed latitudes of 51° N. and 52° N., respectively. The first gave a longitude of 15° 46′ W. and the second of 11° 51′ W. Sun bore per compass at the time S. 28° 30′ E. Find the true bearing of the sun and error of the compass.

Ans. True bearing S. 22 E. Error of compass 5° 30′ E.

EXAMPLE 53. An observation taken one forenoon and worked with assumed latitudes of 50° 31′ N. and 50° 40′ N., respectively. The first gave a longitude of 15° 30′ W. and the second 15° 23′ W. Sun bore per compass at the time S. 55° E. Find the true bearing and error of the compass.

Ans. True bearing S. 64 E. Error of compass 9° W.

EXAMPLE 54. Sept. 23d, 1890, in latitude 40° 09′ 15″ S., longitude 52° 30′ E., about 6 P.M., the observed bearing of the sun at setting was N. 60° 10′ W. Find the error of the compass.

Ans. 30° 03′ W.

EXAMPLE 55. June 5th, 1891, in latitude 11° 29′ N., longitude 30° W., about 6 h. 10 m. A.M., the observed bearing of the sun at rising was N. 59° E. Find the error of the compass.

Ans. 7° 59′ E.

EXAMPLE 56. Nov. 27th, 1891, in latitude 40° 27′ N., longitude 20° 07′ W., about 4 h. 43 m. P.M., the observed bearing of the sun at setting was S. 73° W. Find the error of the compass. *Ans.* 11° 20′ 34″ W.

EXAMPLE 57. Sept. 24th, 1890, at 3 h. 10 m. P.M., in latitude 10° 15′ N. and longitude 168° E., the observed altitude of the sun's lower limb was 39° 28′; index error + 1′ 15″; height of the eye 18 feet. The sun bore at the time by compass S. 84° 20′ W. Find the error of the compass. *Ans.* 3° 30′ W.

CHAPTER X.

ERROR OF THE COMPASS.

THE error to which the compass is constantly subjected, being compounded of variation and deviation, must necessarily be an ever-changing quantity. In some localities the variation is nearly stationary, but in others there is an annual change more than likely not corrected on the chart, and there are parts of the world where a trifling change in the position of the ship means a comparatively large change in the amount of the variation. The deviation table, as constructed in port, is liable to many changes after the vessel goes to sea. It is not uncommon, after a straight run for several days, to find the deviation change fully half a degree for every degree of alteration in the compass course, and in some instances the compass will jump a point or two without an alteration of the ship's head. This is due to a change of heel, loose iron placed near the compass, boat davits turned in that were before swung out, or the many causes mentioned in the first chapter. From this it will be seen nothing but constant watchfulness of the behavior of the compass can ensure safety; to this end the error of the compass is frequently determined.

The compass bearing of the sun is taken and the true bearing for the same instant is calculated, the difference between

the two being the error, and is marked E. or W. according as the compass bearing falls to the left or right of the true bearing.

Should the error be found to change much, it would be advisable to head the vessel so as to get the error on every few points in that half of the compass most likely to be used during the next few days, and especially so if approaching land.

There are three ways of finding the true bearing of the sun at sea: *by lines of position*, by *an amplitude*, and by *an observed altitude*.

By Line of Position. The most simple method of determining the true bearing of the sun is by the lines of position plotted on the chart and sufficiently accurate for all purposes in navigation.

It has been said the sun always bears at right angles to the line of position: so at any point on the line of position draw a perpendicular and refer it to the true compass on the chart. The direction of this perpendicular is the true bearing of the sun; comparing this with the compass bearing at the time of taking the observation from which the line of position was derived, will give the error.

By an Amplitude. When the sun is rising or setting, its distance from the E. or W. points of the horizon is called its amplitude.

As refraction causes the sun to appear higher than it actually is, and its effect is greatest when the sun is in the horizon, being about equal to the apparent diameter of the sun, the bearing should not be taken for an amplitude when the centre appears in the horizon, but when it is a little more than its diameter plus the dip above the horizon.

Take from Table III the declination of the sun for the Greenwich date and correct it for the Greenwich time. Add together the sine of the declination and the secant of the latitude; from Table V the sum (rejecting 10 in the index) is the sine of the true amplitude, marked E. at rising and W. at setting, and N. or S. as the declination is N. or S. Should the compass amplitude and the true be of the same name, their difference will be the error; if of different names, their sum will be the error for the course the ship is heading. If this error be to the right of the variation on the chart, the deviation will be easterly; if to the left, westerly.

EXAMPLE.

At sea Nov. 27, 1887, in latitude 40° 27′ N., longitude 20° 07 W., about 4h 43m P.M., the observed bearing of the sun at setting was W. 17° S.

L. M. T. 4h 43m P.M.	Dec. 21° 08′ S.	
Long. 1 20 W.	Corr. + 2.42	
G. M. T. 6 03 P.M.	True Dec. 21 10′ 42″ S.	sin 9.55783
	Latitude 40 27 N.	sec 0.11863
		sin 9.67646
Diff. 1 hr. 27″	True amplitude W. 28° 20 S.	
G. M. T. 6h	Compass " W. 17 S.	
Corr. + 162 or 2′ 42″		
	Error 11 20 W.	

If the variation by chart was 10° W. the deviation would be 1° 20′ W. for the point of the ship's head.

By an Observed Altitude. At the time of taking the altitude for time take also the bearing of the sun by compass, and note the heading of the ship; also the heel, and whether to port or starboard.

The preparation of the data in this problem is the same as that for finding the time by observation, and it is usual to combine the two. To find the true bearing, add together the true altitude, latitude, and the polar distance; take the difference between the half sum and the polar distance, and note the remainder. Then add together the secant of the altitude, secant of the latitude (rejecting 10 in each index), cosine of the half sum, and the cosine of the remainder; half the sum of the four quantities will be the cosine of half the true bearing, which, being doubled, will give the true bearing reckoned from the north in north latitude and the south in south latitude.

EXAMPLES.

We will take the first example used in finding the time, and combine the two problems to illustrate the form used in practice.

PREPARATION OF DATA.

W. Time 8h 51m 57s A.M.	Obs. Alt. 22° 29′ 20″
C. − W. 4 54 15	S. D. + 16 00
	I. C. + 2 45

C. Time	1	46	12	Ref.	− 2 20
C. Corr.	−2	12		Dip	− 4 02
				Par.	+ 8
Gr. M. T.	1	44	00 P.M.	True Alt.	22 41 51

Dec.	17°	00′	00″ S.	Diff. 1 hr.	43″
Corr.	+	1	13	G. M. T.	1.7
True Dec.	17	01	13 S.	Corr.	731
	90	00	00	or	+1′ 13″
Pol. Dis.	107	01	13		

SOLUTION.

Alt.	22° 41′ 51″		sec 0.03500
Lat.	35 00 00	sec 0.08664	sec 0.08664
Pol. Dis.	107 01 13	cosec 0.01945	
Sum	164 43 04		
Half Sum	82 21 32	cos 9.12374	cos 9.12374
1st Rem.	59 39 41	sin 9.93604	
2d Rem.	24 39 41		cos 9.95846
		2)19.16587	2(19.20384
		sin 9.58293	cos 9.60192

Local App. Time 8h 59m 58s A.M. Half of true bearing 66° 26′

2

True bearing N. 132° 52′ E.

Local App. Time	8h	59m	58s A.M.	True bearing N.	132° 52′ E.
Equation of Time	−16	01		Com. bearing N.	130 30 E.
Local M. Time	8	43	57 A.M.	Com. Error	2 22 E.
Gr. M. T.	1	44	00 P.M.		
Diff. Time	5	00	03		
	or				
Longitude	75°	00′	45″ W.		

It will be seen from the above example that as it requires very little more work in the solution of the problem for time to obtain the compass error, it is always best to take the bearing of the sun by compass at the same instant the altitude is taken for time and combine the two, as shown in examples.

On April 3, 1888, in the forenoon, in latitude 29° 42′ 30″ S. and east longitude, the observed altitude of the sun's lower

limb was 22° 41′ 30″; bearing per compass S. 89° E.; index correction — 2′ 30″; height of the eye 24 feet. Watch time of observation $8^h\ 06^m\ 20^s.5$; slow of chronometer time $8^h\ 08^m\ 14^s$; chronometer correction — $6^m\ 19^s$. Find the longitude and error of the compass.

PREPARATION OF DATA.

W. Time	$8^h\ 06^m\ 20^s.5$ A.M.	Obs. Alt.	22° 41′ 30″
C. — W.	8 08 14	S. D.	+ 16 00
		I. C.	— 2 30
C. Time	4 14 34 .5 A.M.	Ref.	— 2 19
C. Corr.	— 6 19	Dip	— 4 48
		Par.	+ 08
G. M. T.	2d 16 08 15 .5		
or		True Alt.	22 48 01
	3d — $7^h.86$		
Dec.	5° 35′ 00″ N.	Hr. Diff.	57″
Corr.	—7 28	G. M. T.	— 7.86
True Dec.	5 27 32 N.	Corr.	448.02
	90 00 00		or
			— 7′ 28″
Pol. Dist.	95 27 32		

SOLUTION.

Alt.	22° 48′ 01″		sec 0.03533
Lat.	29 42 30	sec 0.06120	sec 0.06120
Pol. Dist.	95 27 32	cosec 0.00198	
Sum	147 58 03		
Half Sum	73 59 01	cos 9.44077	cos 9.44077
1st Rem.	51 11 00	sin 9.89162	
2d Rem.	21 28 31		cos 9.96875
		2)19.39557	2)19.50605
		sin 9.69778	cos 9.75302

Local App. Time $8^h\ 00^m\ 43^s$ A.M.
Equation Time + 3 15

Local M. Time 8 03 58 A.M.
Gr. M. Time 4 08 15 5 A.M.

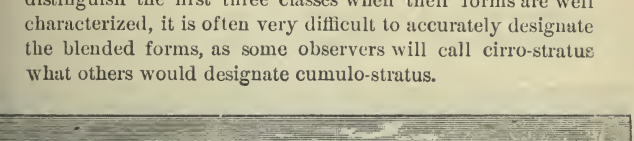
Diff. Time 3 55 42.5
Longitude 58° 55′ 37″ E.

Eq. Time Table, IV.,	+3m 10s	Half of true bearing	55°	30′ 37″
Daily Variation	18s			2
Correction, Table IV*a*,	5			
		True bearing S.	111	01 14 E.
Equation of Time	+ 3 15	Compass bearing S.	89	E.
		Compass error	22	01 14 W.

CHAPTER XI.

Causes that affect Navigation at Sea.

Clouds. The general appearance of the clouds tends greatly to assist the navigator in foretelling the state of the weather; and according to their form they are divided into three classes, called *cirrus*, *cumulus*, and *stratus*. There are four other forms in which these are blended, known as *cirro-cumulus*, *cirro-stratus*, *cumulo-stratus*, and *nimbus*. Though it is easy to distinguish the first three classes when their forms are well characterized, it is often very difficult to accurately designate the blended forms, as some observers will call cirro-stratus what others would designate cumulo-stratus.

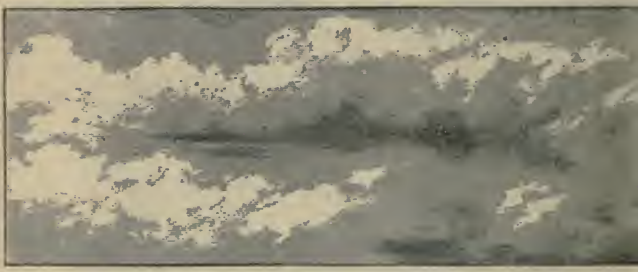


Cirrus.

The Cirrus are composed of thin filaments, resembling a brush, and at times woolly hair or slender network. These

are the most elevated clouds, and their appearance often precedes a change of weather. In summer they announce rain; in winter, frost or snow.

The Cumulus appear in the form of a hemisphere resting on a horizontal base; sometimes these hemispheres rest one



CUMULUS.

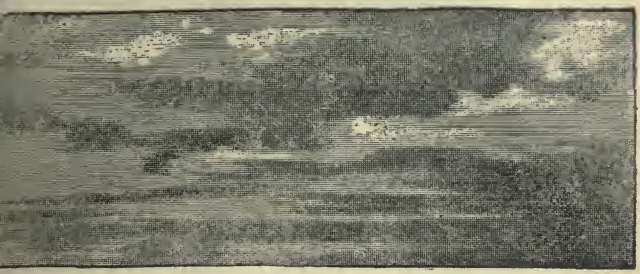
upon the other, and form those great clouds which accumulate on the horizon, and look like distant mountains covered with snow. They predict warm southerly winds.

The Stratus are the horizontal bands, which form fre-

STRATUS.

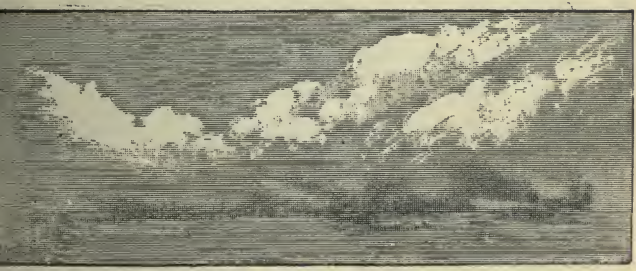
quently at sunset, and, combining with the other two forms, indicate what might be expected in the state of the weather—moisture.

Cirro-cumulus appear as a number of little round, fleecy clouds, and foretell heat.



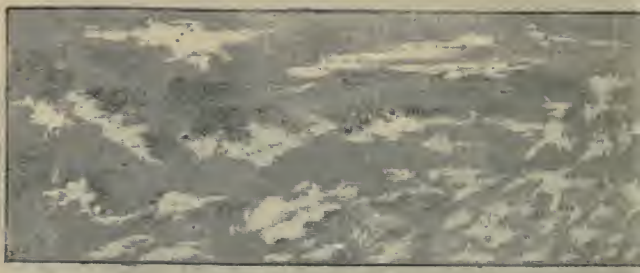
CIRRO-CUMULUS.

Cirro-stratus are composed of little bands of filaments, more compacted than those of the cirrus, and not so high, of a grayish tint, and hardly ever fail to form rain.



CIRRO-STRATUS.

Cumulo-stratus are formed from the cumulus clouds becoming more dense, or heaped together. If they appear in the morning, rainfall may occur, but will cease near noon as a rule; and when they form about noon, rain may follow, but will cease towards evening.



CUMULO-STRATUS.

Nimbus are the dense black clouds with gray-fringed edges, and are variously composed of the other forms, mainly

NIMBUS.

of the compacted cumulus, and are always accompanied by rain, wind, or storms.

Storms and **Currents** are most uncertain causes that endanger the position of the ship at sea, and should, be carefully guarded against.

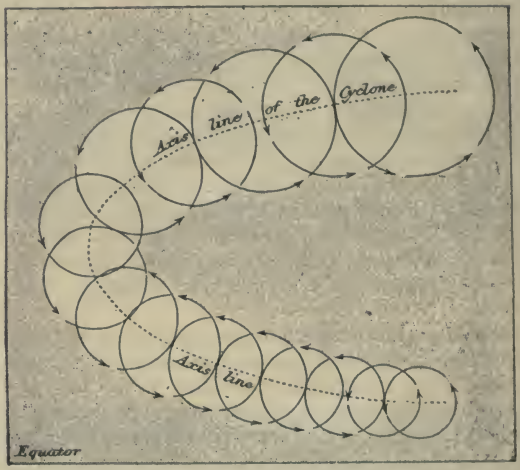
Storms. Wind is air in motion caused by difference of temperature, and the direction is designated by the point of the compass from which it blows. When this difference of temperature is great the motion of the wind is exceedingly heightened, and in some cases in the region of a mountainous

coast it rushes suddenly down with almost irresistible force. The wind blowing in great violence in one direction is called a **straight-line gale.** The most severe gales met with, however, at sea, are commonly known as **revolving storms,** variously called hurricanes, typhoons, and cyclones, according to the locality in which they blow. These revolving storms have two motions—one in a circle like a whirlwind, and the other a forward movement on a curved track. Knowing these two movements, the problem then to be considered in relation to the safety of the ship is: 1st. Ascertain the character of the storm and locate its centre. 2d. Determine which half of the storm-centre the ship is in. 3d. The direction in which the storm is moving. 4th. What to do with the ship to escape the centre, or take advantage of the fair winds.

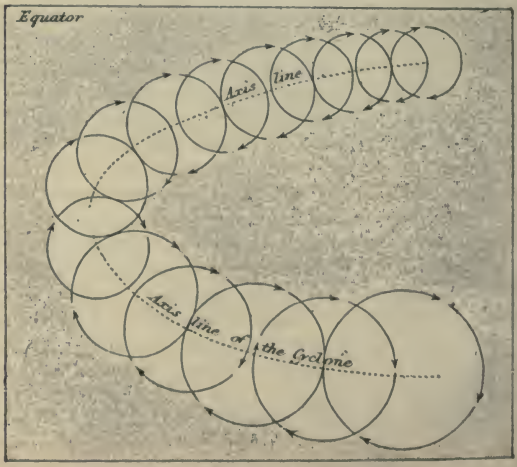
The character of the storm is indicated by the weight of the atmosphere, and as heat and moisture are the principal causes of the variation in the weight of the atmosphere, it follows that the temperature and degree of moisture should be known at the time of observation. The **barometer** is an instrument for measuring the weight, the **thermometer** gives the temperature, and the **hygrometer** the degree of moisture in the air.

The Barometer. There are various forms of the barometer, but the one best suited for observations is the mercurial, consisting of a brass tube about 33 inches in length, the extremity of which is inserted into a small cistern. In order to maintain the mercury in the cistern at the same level, the cistern is constructed partly of leather. By means of a screw at the bottom, the surface of the mercury in the cistern may be so adjusted as to have it always at the place from which the scale commences. The upper part of the tube is cut through so as to expose the column of mercury. Attached to one side of this opening is a scale graduated in inches and parts; and inside this slides a small tube carrying a vernier, which is moved up or down by a small thumb-screw. A thermometer is attached to the barometer to indicate the temperature of the mercury in the cistern. When suspended for use the barometer should hang freely in a vertical position, exposed in the shade where no local heat or cold is liable to affect it

[NORTHERN HEMISPHERE]



[SOUTHERN HEMISPHERE]



THE TWO MOTIONS OF A CYCLONE.

Whenever opportunity offers, the barometer should be compared with a standard, and the corrections noted.

A want of absolute information as to the mean level of the mercury will not prevent advantage being taken of barometrical observations in practical navigation; yet it is best to know the mean level at the position of the observer. Monthly charts issued by the Hydrographic Office of the Navy Department, a branch office of which is located at all large maritime cities in the United States, gives the mean level of the barometer at a great many positions in the Atlantic and a few in the Pacific Ocean. In the absence of these charts, the following table, according to Maury, is most reliable for each parallel of latitude in the North Atlantic, from the equator to seventy degrees North.

North latitudes.	Height of barometer.	North latitudes.	Height of barometer.	North latitudes.	Height of barometer.
	Inches.	°	Inches.	°	Inches.
Equator.	29.918	25	30.119	50	30.001
5°	29.910	30	30.182	55	29.989
10	29.941	35	30.162	60	29.878
15	29.989	40	30.111	65	29.839
20	30.052	45	30.052	70	29.800

The Thermometer is an instrument founded on the principle that most bodies expand by heat and contract by cold. Its construction differs from the barometer in having the tube closed at both ends. There are three descriptions of thermometers in common use, constructed on the same principle, but differing in the division of their respective scales. Fahrenheit's thermometer is the one generally used in America, and is marked from melting ice at 32 degrees to boiling water at 212 degrees, the interval being divided into 180 equal parts. The same graduation is extended downwards to zero and below. The bulb should be kept dry, and exposed in the shade to the open air.

The Hygrometer is simply a thermometer with the bulb wrapped in a little muslin bag, or a kind of wick reaching from it into a small cistern of water from one to three inches away. The difference in the reading of the wet and dry thermometers gives the evaporating power of the air, upon

which depends the amount of moisture present. The thermometer and hygrometer should be enclosed in a case having a lattice front.

Approach of a Storm. The indications of the approach of a storm are : a restless state of the barometer ; a hard gray sky or one having a greenish tint ; a blood-red or bright-yellow sunset; a heavy swell, and a thick, lurid appearance of the sky, in connection with a general threatening condition of the weather. No great storm ever sets in with a steady rising barometer, and it will blow a storm whenever the barometer rises or falls suddenly. The barometer will not rise much in front of a slowly moving storm, but the banking up of air on the border in front of a rapidly moving storm will often cause it to rise suddenly. A very rapid fall of the barometer after fairly entering the storm may be regarded as evidence of a very violent storm of small diameter, while a gradual fall would indicate the contrary. In the North Atlantic, anywhere between the equator and 30 degrees north latitude, when the barometer is observed to fall at the rate of .02 of an inch per hour and to reach a point from .2 to .3 below the mean level, precautions should be taken against the approaching storm. Gales will last a longer or shorter time, and are foretold twelve hours at least and sometimes twenty-four hours in advance, according as the rise or fall of the barometer is more or less rapid. A northerly wind will produce a high or rising barometer, and a southerly wind a low or falling barometer ; hence, the barometer being very high, with northerly winds, a sudden fall accompanied by rise of the thermometer indicates that the wind will back with great force to the southward. Should the barometer be very low, a sudden rise with a falling thermometer predicts a change of wind from the SW. to the NW. and a northerly gale. In winter a sudden fall of the barometer and the thermometer towards the freezing-point indicates snow. Off the coast of the United States the region traversed by the Gulf Stream is remarkable for its high temperature and for squally and uncertain weather, especially in winter. When the winds from W. to SW. blow a gale the heat of the atmosphere reaches its extreme, while beyond the northern and eastern limits of the storm is extremely cold. Should a storm be blowing from the NE

and the barometer begin to fall with a rise of the thermometer, the wind will haul to the E. and SE.; but should the barometer suddenly rise more, with a falling thermometer, the wind is liable to shift suddenly and with great force to the NW., and come out clear and cold.

To Locate the Centre. When facing the wind the centre of the storm will bear eight points to the right in the northern or eight points to the left in the southern latitudes; because in the northern portion of the globe the wind within the storm revolves from the right to left or left-handed, and in the southern part the wind revolves from the left to right or right-handed. Hence, when north of the equator, at the west point of the storm-circle the wind is north and the centre bears east; and south of the equator, at the west point of the storm-centre the wind is south and the centre bears east. If the barometer falls at the rate of .03 of an inch per hour and gets from .4 to .5 below the mean level, the indication is that the centre of the storm is about two hundred miles off; with an hourly fall of .05 to a point .78 of an inch below the mean level, the vessel may be considered about one hundred miles off. With a fall of .09 to 1.5 per hour below the mean level, the vessel will be very close to the centre, if not in it. When the barometer begins to rise again, at first very quickly and afterward with a more moderate movement, the centre of the storm will be travelling away from the ship, and the danger is over.

Semicircles of the Storm. The storm-circle is divided into two equal parts by the storm track, and that portion on the right side looking in the direction of the track is termed the right semicircle, while that portion to the left is called the left semicircle.

In the right semicircle the change of wind will be to the right, and in the left semicircle the change will be to the left; therefore the first change of wind will indicate which half of the storm-circle the ship is in. Should the vessel be directly on the track of the storm or near it on either side there would be no perceptible change of wind, but a falling barometer would indicate the vessel was in front and a rising barometer in rear of the storm.

Direction of Storm Track. The approximate direction in which the storm is moving may be found by plotting on

the chart the position of the ship and centre of the storm on two or more bearings as the wind changes, using the distance of the centre by barometer, and keeping an accurate account of the distance made by the ship in the interval.

To Avoid the Centre. Having ascertained the above data, it becomes necessary now to determine what to do with the ship to escape the centre or place the vessel in a position to incur the minimum amount of danger or take advantage of the fair winds as the case may be.

The rules to be observed are given in the following storm-cards.

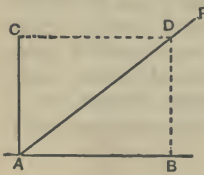
Currents. A current is a progressive motion of the water, occasioned by prevailing winds and differences of temperature and density, and causes all floating bodies to move in the direction of its set. The *set* is that point of the compass towards

which the waters run, and its *drift* is the rate it runs per hour. The effect of a constant or prevalent wind produces what is called a *drift current*, is generally shallow, and hardly ever exceeds half a mile per hour with a good breeze. The accumulation of the drift into a collective mass by the intervention of some obstacle produces what is called a *stream current*. It takes the direction imposed by the obstacle, and in many cases is a deep, powerful stream, not unlike a river in the ocean. These two forms of current cause a constant circulation to be going on in the waters of the globe, and are usually marked on

the charts with the set and drift given. As they are liable to vary in both speed and direction and temporary eddies not marked on the chart, their existence and influence may be found by a comparison between the position by dead-reckon-

ing and that by observation, corroborated by a change in the temperature or density of the water.

Current Sailing. With the set and drift of a current known, it can be allowed for in the following manner: Draw a line AB on the chart in the direction of the set, and from the position of the ship A lay off on this line AB equal to the hourly drift, taking the measurement from any convenient scale, say an inch to the mile. With the same scale at A erect a perpendicular to AB, and lay off on this perpendicular AC equal to the vessel's speed per hour; draw CD parallel to AB, and BD parallel to AC. In order then to make good the intended course AD, and keep the objective point P constantly on the same line of bearing, the vessel will have to steer in the direction of AC. The scale on the chart will be found too small to give a working size to the figure; however, it can be used by multiplying the drift of the current and the rate of the vessel by some convenient number.



Icebergs. The currents from the polar regions bring with them great quantities of floating ice, and the presence of these icebergs constitutes a very serious danger to navigation. The latitudes in which these floating islands are to be met with are generally marked on the chart, and when in those regions no precaution should be neglected to discover them before the danger becomes too great.

A large iceberg will denote its presence, even on the darkest night, by a sort of whiteness or halo known as "*ice blink*." The echo of a gun or steam-whistle is liable to detect the presence of an iceberg; and should one be to windward, the temperature of the air would indicate its proximity. The temperature of the water cannot be relied upon as a means of detecting the presence of ice.

Should a berg be discovered, always endeavor to pass on the weather side on account of the loose pieces drifting more rapidly.

CHAPTER XII.

Aids to Navigation.

When the vessel on her course leaves the deep water and comes upon soundings, the fact is at once known by a change in the temperature of the water and the blue appearance of the sea changing to a decided green color. The evidence of approaching shore is noted in the presence of birds, floating objects, nature of the swell of the sea, and the sense of smell. The land is first seen in an outline resembling a thick cloud, but which can hardly be mistaken.

In making the proper point or working the way into port it is advantageous to observe the nature of the shore, complexion of the land, and configuration of the coast-lines, also by noting an isolated tree, church spire, windmill or prominent mountain.

In addition to these, all maritime countries have established a well-concerted series of landmarks as aids to navigation, such as light-houses, light-vessels, buoys, beacons, and fog-signals.

Light-houses. The light-house is not only a house or tower especially adapted for showing a light at night, but serves as a landmark by day. They are sufficiently diversified by different characteristics to properly define their respective positions.

As we approach the shore from seaward the most salient points of the coast-line are marked by first-class light-houses. These are located near each other, that one or more of them may be observed except in dense fog and thus the vessel avoid any danger from the obstructions they mark, and the navigator be enabled to correct any errors in his estimated position.

Secondary capes, reefs, etc., to which it is prudent to give a good offing, are marked by second- and third-class light-houses, whose light has a range regulated by what is considered a safe distance in which to navigate the vessel. During thick weather

SEA-COAST LIGHT-HOUSE AT CURRITUCK BEACH, NORTH CAROLINA.

the range of the first-class lights is greatly diminished in power and extent when those of the second class assist to fill up the vacancy thus caused in the primary illumination. Lights of these classes are also placed to mark the mouths of rivers and the entrance to ports only accessible by narrow channels, and to point out the exact course which should be steered.

Near the port or anchorage a small harbor light is placed upon one or each of the banks, piers, or breakwater as a guide to a good berth. Many of these small lights belonging to tidal harbors are not exhibited until the tide has reached a certain determined height.

Order of Lights. In the United States the lights are divided into six orders. Lights of the first order are those established to give warning of the approach to land; those of the second, to mark the secondary points or headlands along the sea-coast and the approach to bays and sounds; third-order, lights are used in bays that are of considerable width and intricacy, and for the coast of lakes; lights of the fourth, fifth, and sixth orders mark the most prominent points, headlands, or shoals in the long bays, sounds, or obstructions in rivers, and piers or wharves.

Character of Lights. In addition to the division of lights according to their position for illumination, provision is made for their easy distinction so as to not mislead by a close resemblance of one to the other. To this end lights are divided into several distinctive characters—the fixed, revolving, flash or intermittent, and double light on one or two towers.

The Fixed Light is one which exhibits a regular and steady appearance, and is not subject to any change.

The Revolving Light gradually increases to a maximum and diminishes to a minimum until wholly extinguished at equal intervals of half a minute, one, two, or three minutes, and sometimes thrice a minute. It is produced by the revolution of a three- or four-sided frame having large reflectors grouped on each side, with their axes parallel.

The revolving light is subdivided into other classes, such as revolving white, revolving red and white, revolving red with two whites, or revolving white with two reds, obtained by the revolution of a frame whose sides present red and white lights in succession.

Bug Light.

LAKE-COAST LIGHT-HOUSE AT GROSSE POINT.

The Flash or Intermittent Light is one in which the ray suddenly appears, remains visible for a moment, and afterwards is again suddenly eclipsed for a brief interval. This is due to the perpendicular motion of circular shades in front of the reflector by which the light is alternately revealed and hidden. This light and the revolving light are sometimes combined to form the revolving flash light.

The Double Lights are seldom used except where a leading line is needed as a guide for taking some narrow channel or avoiding some danger. They are generally exhibited from two towers, one of which is higher than the other, and produce marked characteristic distinction or serve as a range to avoid danger. In the first case the distance between the lights is such as to prevent the two being blended into or supposed to be one lightt within the limits of their ranges. In the second case they are so arranged they will be seen to separate the moment of departure from the straight range line they are placed to mark. Frequently a very small arc is illuminated by one light which can be seen before encountering danger.

Colored Lights. Another means of distinguishing the various lights is in their color: some are red, with an intense ruddy-like splendor; others white, and some blue or green. However, colored lights should be observed with caution, as the use of coloring matter reduces in great proportions the intensity of the light; and the atmospheric conditions sometimes determine the color, which may lead to mistake as to the real color of the light. It has been observed that during foggy weather white lights become of a reddish color or tinge; green appears to approach in color or become white; and blue lights are not visible or change to so pale a violet tint as to be mistaken for white. But if there be two lights of different color, such as red and white, one becomes intensely red and the other a red tinge, both preserving their distinctive character. If green were in place of red, the two lights would appear to be red and white without a marked difference in color. Some heavy fogs, however, allow all the luminous rays to pass through them equally without coloring them, and only have the effect of diminishing their intensity. With equal intensity, the red light will be seen farther than the white light; but if the two are used, the white light will cease to be visible before the red light.

The electric light possesses a great distinction of color, but very little superiority in penetrating power in thick weather, and at any time is blinding, or its distance hard to ascertain.

Range of Lights. The distance at which a light may be seen depends upon its intensity and height above the sea or its luminous and geographical range. The luminous range de

CRAIGHILL'S CHANNEL RANGE LIGHTS.—HIGH LIGHT.

pends upon the state of the atmosphere and the acuteness of the eye of the observer.

The geographical range depends upon the height above the level of the sea, upon the curvature of that part of the earth's surface at which it is placed, and upon the value of atmospheric refraction.

In the United States the heights of all light-houses are given in the lists and nautical books for mean low-water, together with range corresponding to different heights above the level of the sea both for the focal point and the eye of the observer. In some countries the tables are made out with reference to the level of the highest water.

CRAIGHILL'S CHANNEL RANGE LIGHTS.—LOW LIGHT.

By a reference to the chart, light list, and sailing directions a minute description and sketch of all light-houses will be found, their position accurately noted, the character and brilliancy of the light, the order or class, bearings on which the light is visible or obscured, height of the centre of the lantern above the high-water level or mean low tide; height

also of the building from the base to the vane, and its form, color, and other peculiarities.

Light-ships. The seas adjacent to the coast are sometimes interspersed with extensive shoals and shifting sand-banks, upon which it is impossible to erect light-houses. Nor can those already built upon the mainland be made serviceable in directing vessels their way through the narrow channels running in all directions, distant perhaps fifteen or twenty miles off the coast.

In approaching the sea immediately surrounding these dangers, light-ships or floating lights are used to indicate the exact points to be avoided. They also serve as beacons against variable currents and reefs which are hidden at certain hours by the high tide.

Each light-ship, like the light-house on shore, is distinguished by its own peculiar aspect, various characteristics, and certain differences in telling not only one from another, but also from any neighboring light-house.

How appear. When seen at some distance a light-ship closely resembles during the day an ordinary vessel, but upon approaching near a great difference between the two is seen. The short stout masts are without sails, and surmounted by large balls, cages, or other marks.

LIGHT-SHIP.

In Great Britain the hulls of light-ships are painted red and black. In the United States they are painted such color and in such a way as the Light-house Board may designate, with the name of the station painted on the sides and the number of the vessel on the stern.

At night these vessels are provided with one or more lights, and are distinguished by their number and position as well as characteristic distinction—such as single or double fixed lights, revolving lights with varying intervals of darkness between the beams, or with colored beams alternating with white, or colored beams only.

When two lights are used, it is usually the custom to place one higher than the other.

Few instances are on record of a light-ship having broken loose from her moorings. If, however, the ship should be driven from its place by the force of the elements, so that its light may become a source of danger, means are provided for signalling by flags or the firing of a gun. No one except those belonging to the light-ships is ever permitted to live on board or to remain at night, unless necessarily detained by stress of weather, or wrecked persons who may be compelled to take temporary refuge on board.

Buoys are the next very important marks that contribute greatly as aids to navigation. They are exceedingly numerous, and are invaluable as guiding marks by day through narrow channels and warning marks for isolated dangers. They are not very serviceable at night, being unilluminated; however, buoys have been lit in many instances by the application of compressed gas confined within the buoy; and it has been proposed to connect them with wires all around the coast, and to light them simultaneously with electricity.

Distinction. Their chief elements of distinction are the form, size, and color, which may be supplemented by the addition of a shape—such as globe, diamond, triangle, etc.—mounted on top of the mast fixed in the head of the buoy.

Names of Buoys. The names of the various forms are so unsettled, that but few persons can accurately state what constitutes the characteristic of each. However, the descriptive titles of buoys are: the nun, can, conical, convex, spiral, drum, cylinder, spherical, spar, mast, and cask. These terms are found to vary at different places, and are employed to give

exactly opposite indications; also, intimations conveyed by colors vary at different places: hence, reference to name or disposition of colors is apt to lead to some confusion.

In France a uniform system of coloring is used, and on each is painted either the entire or abridged name of the rock or bank that it marks; those belonging to the same channel are numbered serially, commencing to seaward. Those to mark the starboard side are painted red, having a white crown a little below the summit, and bear the even numbers. Those to mark the port side are painted black, and bear odd numbers. Those which may be left indifferently on either side are painted with horizontal stripes alternately red and black, bear names, but no numbers. The red and black are varied, as circumstances require, by painting in white designs of checks, vertical bands, etc.

In England the entrances to channels or turning-points are marked by conical buoys with or without staff, and globe or triangle, cage, etc. Single-colored can-buoys, either red or black, mark the starboard side, and buoys of the same shape and color, either checkered or vertical-striped with white, mark the port side. Other distinctions are used, when required, by the employment of conical buoys with or without staff, globe, or cage, globes being on the starboard side and cages on the port hand. Where a middle ground exists in a channel, each side of it is marked by a buoy of the color in use in that channel, but with annular bands of white, and with or without staff, diamond, or triangle. In case of its being of such extent as to require intermediate buoys, they are colored as if on the side of a channel. At times the outer buoy is marked by a staff and diamond, and the inner end by a staff and triangle. Wrecks are marked by green nun-buoys placed on the wreck next to mid-channel, with "Wreck" painted thereon; also two balls or two lights, as the case may be.

Each buoy is marked with a running number, and the name of the locality where it belongs.

In the Netherlands, with few exceptions, white buoys must be left on the starboard hand on entering the channel from seaward, and black buoys on the port hand. Outside buoys, and those indicating where the division of a channel begins, are painted red. In Belgium the same system prevails. In Norway and Sweden a white stake with a broom turned up-

wards denotes that the shoal lies to the north or east of the mark. A black stake with a broom turned downwards denotes that the danger lies to the south or west of the mark. A stake with white and black horizontal stripes, surmounted by a ball or a pole with a cross at the top, may be passed on either side.

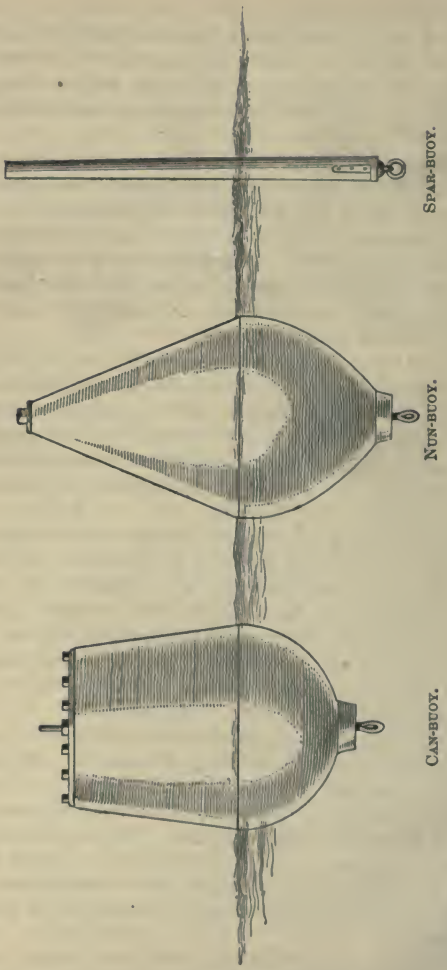
In Russia the system is nearly the same as in Norway, with this addition for the open sea: a red broom open upwards on a red pole means that the danger lies to the north; a black broom open downwards on a white pole means that the danger lies to the south. Two black brooms on a black and white checkered pole mean that the danger lies to the west; and a black pole with cross at the top surmounted by a ball means that a vessel can pass on all sides.

In the United States the largest descriptions of buoys are used to mark approaches to channels, seaward bars, and isolated shoals or other obstructions to navigation which lie at considerable distance from the coast. First and second class buoys mark the approaches to, the obstructions in, and to point out and mark the limits of channels leading to the principal ports or harbors along the coast.

They also mark the channels and obstructions adjacent to the coast and those in the large bays and sounds. Second and third class buoys mark the approaches to, and channels and obstructions of, the lesser harbors and bays. Nun and can buoys liable to danger or to be swept away by floating ice are removed on the approach of freezing weather, and spar-buoys put in their places. Small spar-buoys mark channels and obstructions in shoal-water navigation.

Special buoys, such as spherical and cask buoys, colored and numbered, are used to mark special localities. All buoys are placed in the best position to mark obstructions or define channels, and float as high and as nearly upright as possible during the strongest wind and tide. White serial numbers, as large as the class of buoy will permit, are placed on four sides of red and black buoys, and other distinguishing marks are made to show as prominently and at as great a distance as possible.

Different channels in the same bay, sound, river, or harbor are marked as far as practicable by different descriptions of buoys.


Spar-buoy.
Nun-buoy.
Can-buoy.

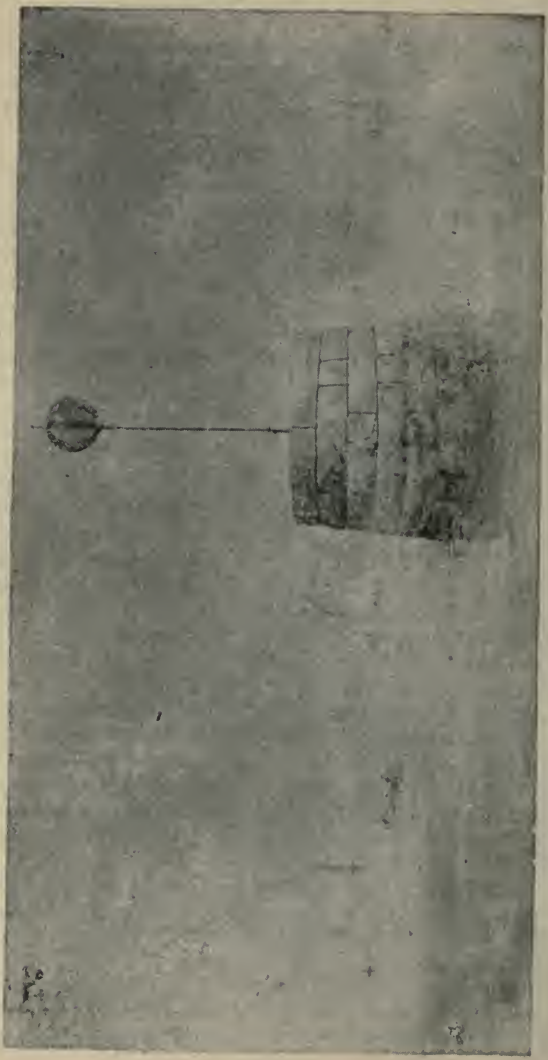
The main channel is marked by nun-buoys; can-buoys indicate secondary channels, and spar-buoys minor channels. When there is but one channel, nun-buoys properly colored and numbered are placed on the starboard side and can-buoys on the port side.

On entering the channel from seaward red buoys with even numbers are placed on the starboard side of the channel, and must be left on the starboard hand in passing in. Black buoys with odd numbers are placed on the port side of the channel, and must be left on the port hand in passing in. Buoys painted with red and black horizontal stripes without numbers are placed on rocks or other obstructions with channels on either side of them, and may be left on either hand in passing in. Buoys painted with black and white vertical stripes without numbers are placed in mid-channel, and must be passed close to avoid danger. Buoys to mark abrupt turning-points in channels or obstructions requiring a specific and permanent mark are fitted with staves surmounted by balls, cages, triangles, or other distinctive marks, the color indicating which side they shall be passed. Yellow buoys without numbers are used to mark any danger at a quarantine station.

The bearings from one mid-channel buoy to another in the order of passing to other buoys or objects, the name of the station or position occupied, the color, number, description, class, depth of water at mean low tide, kind of bottom, and such other marks to aid navigation will be found in the proper column of the buoy list.

Beacons are small but durable structures of timber, masonry, or iron, placed on low, outstretching points of land, rocks and sand-banks, shoals or elsewhere, which at certain times of the tide are hidden from view, in estuaries and broad parts of rivers. They serve as leading marks through certain channels for the avoidance of special dangers, and as a guide for entering harbors or anchorage ground.

Every beacon set up has some especial characteristic, so that it may be recognized, being usually surmounted with a characteristic head in the form of a globe, diamond, cross, or triangle. Beacons are painted in such a manner that the color will cause them to be well defined upon the background, and those on sides of channels are painted the same as buoys. Some of these beacons are provided with a ladder leading up



BEACON ON SEA-FLOWER REEF, L. I. SOUND.

to a refuge cage above the high-water mark, capable of holding several persons. As a general rule, beacons are not lighted up at night; yet several arrangements have been devised for lighting beacons on detached rocks which are inaccessible during rough weather.

Sound-signals. The various marks so far dealt with are those which depend upon the sense of sight only; but when sight is unavailing, the sense of hearing naturally suggests itself when sound-signals have to be used as aids to navigation, especially during fogs, mists, and snow-storms. These sound-signals are, with certain modifications: sirens, trumpets, steam-whistles, bell-buoys, whistling-buoys, bells struck by machinery, cannons, rockets, and gongs.

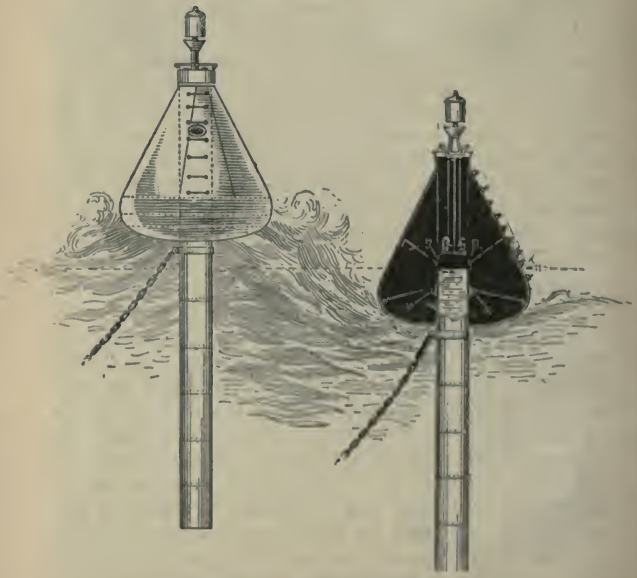
Gongs are sometimes used on light-ships and for close quarters, having an effective range of about 500 yards. They are of most use in harbors, short channels, and like places, where a long range would be unnecessary.

Rockets are used in light-houses as a signal where it would be impossible to mount large pieces of apparatus. It frequently happens that the sound-signal intended to be heard at a certain distance is obstructed or deflected by intervening obstacles; the rocket in this case overcomes the difficulty. The charge, usually of gun-cotton, is fitted to the head, and the whole projected to the height of perhaps 1000 feet, when the charge is exploded, and sound scattered in all directions, with greater effect than the report of a gun. Some of these rockets have been heard at a distance of twenty-five miles.

Cannon are used for various purposes in connection with signalling. The minute-gun at sea indicates that the vessel is in distress, and that assistance is required. On some light-ships the cannon is used to attract attention of shipwrecked life-boats. They are also used as warning signals on head-lands and dangerous points on a coast, as aids to navigation in foggy weather, as well as for signalling in accordance with an arranged code. Owing to the short duration of sound, the use of the cannon is not so great as it once was, as the observer, either through lack of attention or otherwise, may not hear unless prepared for it, the sound being liable to be quenched by local sounds, or even obliterated by a puff of wind. The interval between each shot was formerly fifteen

minutes, but recently it has been altered to ten; owing, however, to the severe labor and risks accompanying it, this interval is of considerable irregularity.

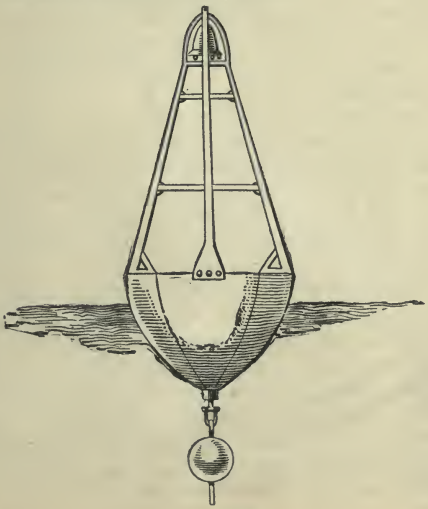
Bells are in use at every light-station, and at many they are run by machinery actuated by clockwork. These bells weigh from 300 to 3000 pounds. The sound of a bell is curiously fluctuating, and the vibrations of the largest bells are not of sufficient intensity to yield a sound capable of overcoming opposing influences, even of a slight nature, and the effective range is at times very doubtful. However, it has been shown by experiments that the range of bell sounds can be increased with the rapidity of the stroke; it has also been somewhat increased by the use of iron reflectors. By this it will be seen that the bell is only used, like the gong, for short distances, and is not efficient for fog-signals on the sea-coast. Owing to rough weather, the noises of the surf will drown the sound to seaward altogether.



COURTENAY'S WHISTLING-BUOY.

The Whistling-buoy, devised by Mr. Courtenay, is extensively employed in various parts of the world. It has a powerful whistle fixed at the top, and sounded automatically by the action of the sea, on the passage of any wave or undulation, which will cause the instrument to rise and fall six inches or more. It will emit a sound that can be heard distinctly from one to fifteen miles,—a mournful sound, which, though of great aid to navigation, is most obnoxious to those who live within ear-shot. They can be used on shoals, where a light-ship is needed but could not live; and are well suited for broken and turbulent waters, as the rougher the sea the louder their sound: they are also employed for roadsteads and the open sea.

The Bell-buoy consists of a buoy with a bell so attached that it will cause the bell to strike as the buoy is moved from side to side by the action of the sea. Like the whistling-buoy, the bell-buoy sounds the loudest when the sea is roughest, but is adapted to shoal water, where the whistling-buoy could not ride. It is preferred for harbors, rivers, and other places where the sound range needed is short.



BELL-BUOY.

Steam-whistles for signalling in a fog are the same instruments ordinarily used on steamboats and locomotives. They have been heard at distances, varying with their diameter, of from three to twenty-five miles.

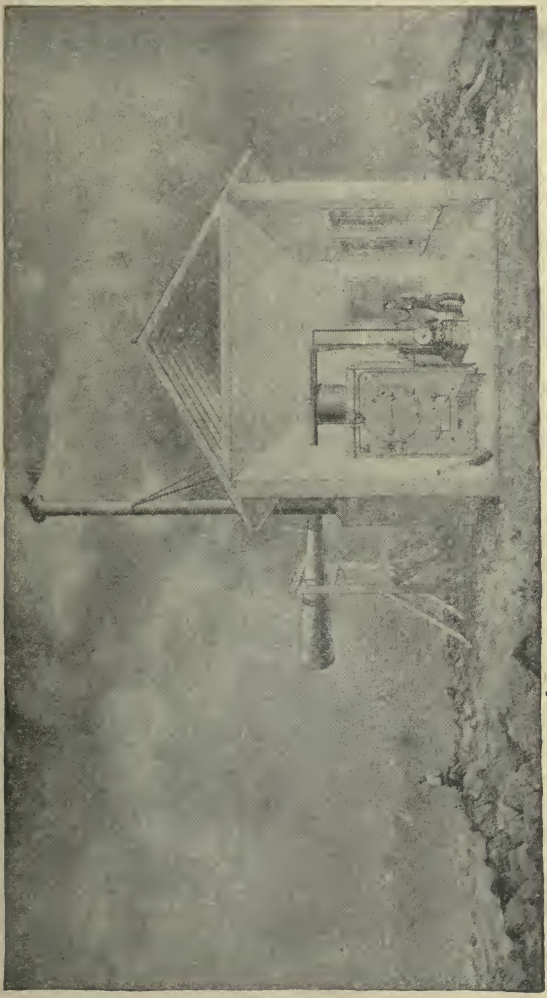
The Trumpet comes next in order, and is simply a horn that is capable of making shrieks which can be heard at a great distance, and is superior to the whistle, having greater penetrating effect.

The Siren is beyond all doubt the most powerful fog-signal in use, and when operated under a pressure of seventy pounds of steam can be heard, under favorable circumstances, from twenty to thirty miles. Its density, pitch, and penetration render it dominant over noises after all other signal sounds have succumbed, especially under meteorological conditions unfavorable to the transmission of sound.

The trumpet, siren, and whistle are capable of such arrangement that the length of blast and interval and the succession of alternating are such as to identify the location of each, so that the position may be determined by the sound. Double sirens of different pitch are sometimes used. There are in addition to these, in various parts of the world, several sound-signals made by utilizing natural orifices in cliffs, through which the waves drive the air in such force and velocity as to produce the sound required.

Sound-signals constitute a large factor in the safety of navigation, and it is necessary that every signal should have its own characteristic to particularly indicate itself, as a light-house is made to proclaim its own individuality by some distinguishing feature. The effect of different atmospheric conditions upon the transmission of sound is very marked, and it has been found by repeated trials that the sound range varies on clear, calm days; hence the minimum range should always be taken as the guide when running by sound. A most important phenomenon, affording confidence in sound-signalling when a light is rendered ineffectual, is the fact that a foggy atmosphere appears to be a highly favorable condition for the transmission of sound; while rain, hail, and snow offer no obstruction, but, on the contrary, have the effect of assisting the passage of sound.

It will be seen from the above that a vessel coming to the coast from beyond the sea will pick up the proper coast-light



THE SYREN.

in fair weather, and in thick weather the fog-signal, and take either as a point of departure and feel the way to the harbor light or fog-signal in the port, thence to a safe anchorage, with comparative security.

CHAPTER XIII.

Regulations for Preventing Collisions at Sea.

The laws of all Maritime Nations require a strict observance of the following rules and regulations for the prevention of collisions at sea.

"Art. 1. In the following rules every steamship which is under sail and not under steam is to be considered a sailing-ship, and every steamship which is under steam, whether under sail or not, is to be considered a ship under steam.

"Rules concerning lights.

"Art. 2. The lights mentioned in the following articles numbered three, four, five, six, seven, eight, nine, ten, and eleven, and no others, shall be carried in all weathers, from sunset to sunrise.

"Art. 3. A sea-going steamship, when under way, shall carry—

"(*a*) On or in front of the foremast, at a height above the hull of not less than twenty feet, and if the breadth of the ship exceeds twenty feet, then at a height above the hull not less than such breadth, a bright white light, so constructed as to show a uniform and unbroken light over an arc of the horizon of twenty points of the compass, so fixed as to throw the light ten points on each side of the ship, namely, from right ahead to two points abaft the beam on either side, and of such a character as to be visible on a dark night, with a clear atmosphere, at a distance of at least five miles.

"(*b*) On the starboard side a green light, so constructed as to show a uniform and unbroken light over an arc of the horizon of ten points of the compass, so fixed as to throw the light from right ahead to two points abaft the beam on the starboard

side, and of such a character as to be visible on a dark night, with a clear atmosphere, at a distance of at least two miles.

"(*c*) On the port side a red light, so constructed as to show a uniform and unbroken light over an arc of the horizon of ten points of the compass, so fixed as to throw the light from right ahead to two points abaft the beam on the port side, and of such a character as to be visible on a dark night, with a clear atmosphere, at a distance of at least two miles.

"(*d*) The said green and red side-lights shall be fitted with inboard screens projecting at least three feet forward from the light, so as to prevent these lights from being seen across the bow.

"ART. 4. A steamship when towing another ship shall, in addition to her side-lights, carry two bright white lights in a vertical line, one over the other, not less than three feet apart, so as to distinguish her from other steamships. Each of these lights shall be of the same construction and character, and shall be carried in the same position, as the white light which other steamships are required to carry.

"ART. 5. (*a*) A ship, whether a steamship or a sailing-ship, which from any accident is not under command, shall at night carry, in the same position as the white light which steamships are required to carry, and if a steamship, in place of that light, three red lights in globular lanterns, each not less than ten inches in diameter, in a vertical line, one over the other, not less than three feet apart, and of such a character as to be visible on a dark night, with a clear atmosphere, at a distance of at least two miles, and shall by day carry in a vertical line, one over the other, not less than three feet apart, in front of but not lower than her foremast-head, three black balls or shapes, each two feet in diameter.

"(*b*) A ship, whether a steamship or a sailing-ship, employed in laying or in picking up a telegraph cable, shall at night carry, in the same position as a white light which steamships are required to carry, and if a steamship, in place of that light, three lights in globular lanterns, each not less than ten inches in diameter, in a vertical line, over one another, not less than six feet apart. The highest and lowest of these lights shall be red, and the middle light shall be white, and they shall be of such a character that the red lights shall be visible at the same distance as the white light. By day she shall carry, in a

vertical line, one over the other, not less than six feet apart, in front of but not lower than her foremast head, three shapes not less than two feet in diameter, of which the top and bottom shall be globular in sphae and red in color, and the middle one diamond in shape and white.

"(*c*) The ships referred to in this article when not making any way through the water shall not carry the side-lights, but when making way shall carry them.

"(*d*) The lights and shapes required to be shown by this article are to be taken by other ships as signals that the ship showing them is not under command, and cannot therefore get out of the way. The signals to be made by ships in distress and requiring assistance are contained in article twenty-seven.

"ART. 6. A sailing-ship under way or being towed shall carry the same lights as are provided by article three for a steamship under way, with the exception of the white light, which she shall never carry.

"ART. 7. Whenever, as in the case of small vessels during bad weather, the green and red side-lights cannot be fixed, these lights shall be kept on deck, on their respective sides of the vessel, ready for use, and shall, on the approach of or to other vessels, be exhibited on their respective sides in sufficient time to prevent collision, in such manner as to make them most visible, and so that the green light shall not be seen on the port side nor the red light on the starboard side. To make the use of these portable lights more certain and easy, the lanterns containing them shall each be painted outside with the color of the light they respectively contain, and shall be provided with proper screens.

"ART. 8. A ship, whether a steamship or a sailing-ship, when at anchor, shall carry, where it can best be seen, but at a height not exceeding twenty feet above the hull, a white light, in a globular lantern of not less than eight inches in diameter, and so constructed as to show a clear, uniform, and unbroken light, visible all round the horizon at a distance of at least one mile.

"ART. 9. A pilot vessel, when engaged on her station on pilotage duty, shall not carry the lights required for other vessels, but shall carry a white light at the mast-head, visible all round the horizon, and shall also exhibit a flare-up light

or flare-up lights at short intervals, which shall never exceed fifteen minutes. A pilot vessel, when not engaged on her station on pilotage duty, shall carry lights similar to those of other ships.

"ART. 10. Open boats and fishing-vessels of less than twenty tons net registered tonnage, when under way and not when having their nets, trawls, dredges, or lines in the water, shall not be obliged to carry the colored side-lights; but every such boat and vessel shall in lieu thereof have ready at hand a lantern with a green glass on the one side and a red glass on the other side, and on approaching to or being approached by another vessel such lantern shall be exhibited in sufficient time to prevent collision, so that the green light shall not be seen on the port side nor the red light on the starboard side.

"The following portion of this article applies only to fishing-vessels and boats when in the sea off the coast of Europe lying north of Cape Finisterre:

"(*a*) All fishing-vessels and fishing-boats of twenty tons net registered tonnage or upward, when under way and when not having their nets, trawls, dredges, or lines in the water, shall carry and show the same lights as other vessels under way.

"(*b*) All vessels when engaged in fishing with drift-nets shall exhibit two white lights from any part of the vessel where they can be seen. Such lights shall be placed so that the vertical distance between them shall not be less than six feet and not more than ten feet, and so that the horizontal distance between them, measured in a line with the keel of the vessel, shall be not less than five feet and not more than ten feet. The lower of these two lights shall be the more forward, and both of them shall be of such a character and contained in lanterns of such construction as to show all round the horizon, on a dark night, with a clear atmosphere, for a distance of not less than three miles.

"(*c*) All vessels when trawling, dredging, or fishing with any kind of drag-nets shall exhibit, from some part of the vessel where they can be best seen, two lights. One of these lights shall be red and the other shall be white. The red light shall be above the white light, and shall be at a vertical distance from it of not less than six feet and not more than twelve feet; and the horizontal distance between them, if any, shall not be more than ten feet. These two lights shall be of

such a character and contained in lanterns of such construction as to be visible all round the horizon, on a dark night, with a clear atmosphere, the white light to a distance of not less than three miles and the red light of not less than two miles.

"(*d*) A vessel employed in line-fishing, with her lines out, shall carry the same lights as a vessel when engaged in fishing with drift-nets.

"(*e*) If a vessel when fishing with a trawl, dredge, or any kind of drag-net, becomes stationary in consequence of her gear getting fast to a rock or other obstruction, she shall show the light and make the fog-signal for a vessel at anchor.

"(*f*) Fishing-vessels and open boats may at any time use a flare-up in addition to the lights which they are by this article required to carry and show. All flare-up lights exhibited by a vessel when trawling, dredging, or fishing with any kind of drag-net shall be shown at the afterpart of the vessel, excepting that if the vessel is hanging by the stern to her trawl, dredge, or drag-net they shall be exhibited from the bow.

"(*g*) Every fishing-vessel and every open boat when at anchor between sunset and sunrise shall exhibit a white light, visible all round the horizon at a distance of at least one mile.

"(*h*) In a fog a drift-net vessel attached to her nets, and a vessel when trawling, dredging, or fishing with any kind of drag-net, and a vessel employed in line-fishing with her lines out, shall, at intervals of not more than two minutes, make a blast with her fog-horn, and ring her bell alternately."

Attention is called to paragraphs "*a*" and "*c*" of this article, which have not been adopted by foreign governments.

Paragraph "*a*" has been modified by the British Government to read as follows, viz.:

"All fishing vessels and fishing-boats of twenty tons net registered tonnage or upwards, when under way and when not required by the following regulations in this article to carry and show the lights therein named, shall carry and show the same lights as other vessels under way."

Paragraph "*c*" has been omitted.

But these two provisions apply only to "fishing-vessels and boats when in the sea off the coast of Europe lying north of Cape Finisterre."

"ART. 11. A ship which is being overtaken by another

shall show from her stern to such last-mentioned ship a white light or a flare-up light.

"SOUND SIGNALS FOR FOG, AND SO FORTH.

"ART. 12. A steamship shall be provided with a steam-whistle or other efficient steam sound-signals, so placed that the sound may not be intercepted by any obstructions, and with an efficient fog-horn, to be sounded by a bellows or other mechanical means, and also with an efficient bell. (In all cases where the regulations require a bell to be used, a drum will be substituted on board Turkish vessels.) A sailing-ship shall be provided with a similar fog-horn and bell.

"In fog, mist, or falling snow, whether by day or night, the signals described in this article shall be used as follows, that is to say:

"(*a*) A steamship under way shall make with her steam-whistle or other steam sound-signal, at intervals of not more than two minutes, a prolonged blast.

"(*b*) A sailing-ship under way shall make with her fog-horn, at intervals of not more than two minutes, when on the starboard tack one blast, when on the port tack two blasts in succession, and when with the wind abaft the beam three blasts in succession.

"(*c*) A steamship and a sailing-ship when not under way shall, at intervals of not more than two minutes, ring the bell.

"SPEED OF SHIPS TO BE MODERATE IN FOG, AND SO FORTH.

"ART. 13. Every ship, whether a sailing-ship or a steam-ship, shall in a fog, mist, or falling snow go at a moderate speed.

"STEERING AND SAILING RULES.

"ART. 14. When two sailing-ships are approaching one another so as to involve risk of collision, one of them shall keep out of the way of the other as follows, namely:

"(*a*) A ship which is running free shall keep out of the way of a ship which is close-hauled.

"(*b*) A ship which is close-hauled on the port tack shall keep out of the way of a ship which is close-hauled on the starboard tack.

"(*c*) When both are running free, with the wind on different sides, the ship which has the wind on the port side shall keep out of the way of the other.

"(*d*) When both are running free, with the wind on the same side, the ship which is to windward shall keep out of the way of the ship which is to leeward.

"(*e*) A ship which has the wind aft shall keep out of the way of the other ship.

"ART. 15. If two ships under steam are meeting end on, or nearly end on, so as to involve risk of collision, each shall alter her course to starboard, so that each may pass on the port side of the other. This article only applies to cases where ships are meeting end on, or nearly end on, in such a manner as to involve risk of collision, and does not apply to two ships which must, if both keep on their respective courses, pass clear of each other. The only cases to which it does apply are when each of the two ships is end on, or nearly end on, to the other; in other words, to cases in which by day each ship sees the masts of the other in a line, or nearly in a line, with her own, and by night to cases in which each ship is in such a position as to see both the side-lights of the other. It does not apply by day to cases in which a ship sees another ahead crossing her own course, or by night to cases where the red light of one ship is opposed to the red light of the other, or where the green light of one ship is opposed to the green light of the other, or where a red light without a green light, or a green light without a red light, is seen ahead, or where both green and red lights are seen anywhere but ahead.

"ART. 16. If two ships under steam are crossing so as to involve risk of collision, the ship which has the other on her own starboard side shall keep out of the way of the other.

"ART. 17. If two ships, one of which is a sailing-ship and the other a steamship, are proceeding in such directions as to involve risk of collision, the steamship shall keep out of the way of the sailing-ship.

"ART. 18. Every steamship, when approaching another ship so as to involve risk of collision, shall slacken her speed, or stop and reverse, if necessary.

"ART. 19. In taking any course authorized or required by these regulations, a steamship under way may indicate that

course to any other ship which she has in sight by the following signals on her steam-whistle, namely:

"One short blast to mean 'I am directing my course to starboard.'

"Two short blasts to mean 'I am directing my course to port.'

"Three short blasts to mean 'I am going full speed astern.'

"The use of these signals is optional, but if they are used the course of the ship must be in accordance with the signal made.

"ART. 20. Notwithstanding anything contained in any preceding article, every ship, whether a sailing-ship or a steamship, overtaking any other shall keep out of the way of the overtaken ship.

"ART. 21. In narrow channels every steamship shall, when it is safe and practicable, keep to that side of the fairway or mid-channel which lies on the starboard side of such ship.

"ART. 22. Where by the above rules one of two ships is to keep out of the way, the other shall keep her course.

"ART. 23. In obeying and construing these rules due regard shall be had to all dangers of navigation, and to any special circumstances which may render a departure from the above rules necessary in order to avoid immediate danger.

"NO SHIP, UNDER ANY CIRCUMSTANCES, TO NEGLECT PROPER PRECAUTIONS.

"ART. 24. Nothing in these rules shall exonerate any ship, or the owner, or master, or crew thereof, from the consequences of any neglect to carry lights or signals, or of any neglect to keep a proper lookout, or of the neglect of any precaution which may be required by the ordinary practice of seamen or by the circumstances of the case.

"RESERVATION OF RULES FOR HARBOR AND INLAND NAVIGATION.

"ART. 25. Nothing in these rules shall interfere with the operation of a special rule, duly made by local authority, relative to the navigation of any harbor, river, or inland navigation.

"SPECIAL LIGHTS FOR SQUADRONS AND CONVOYS.

"ART. 26. Nothing in these rules shall interfere with the operation of any special rules made by the Government of any nation with respect to additional station and signal lights for two or more ships of war or for ships sailing under convoy.

"ART. 27. When a ship is in distress and requires assistance from other ships or from the shore, the following shall be the signals to be used or displayed by her, either together or separately, that is to say:

"In the daytime—

"First. A gun fired at intervals of about a minute.

"Second. The international code signal of distress indicated by N. C.

"Third. The distant signal, consisting of a square flag, having either above or below it a ball, or anything resembling a ball.

"At night—

"First. A gun fired at intervals of about a minute.

"Second. Flames on the ship (as from a burning tar-barrel, oil-barrel, and so forth).

"Third. Rockets or shells, throwing stars of any color or description, fired one at a time, at short intervals."

RELIEF OF THE SICK AND THE WOUNDED.

All commands are liable to be called upon in case of accident to resort to expedients to relieve the sick and wounded in the absence of a doctor. Every one should know how to make a stretcher and how to transport one. The following stretchers may be readily extemporized: 1. A blanket is held by four men, one at each corner, and is then doubled so that the two loops shall be brought together at each end; one pole (or two rifles lashed together) passes through the four loops, while another passes within the double of the blanket on the other side. 2. Roll a small stone into each corner of the blanket and thus form projections which will prevent the slipping of the string or thongs with which it is made fast to a frame of poles, or rifles lashed together. Two coats and four muskets passed through the sleeves makes a good stretcher. Avoid carrying the stretcher on the shoulders. The front and rear bearers of the stretcher should not be out of step, and men of equal height and strength should be selected. The sick or wounded man should be carried with his face toward the direction in which he is moving. In crossing hollows, fences, etc., the stretcher should be kept horizontal. Each officer and non-commissioned officer on going into the field should carry on his person a bandage and a piece of lint, and should understand how to put on a bandage so as to stop severe hemorrhages.

Sunstroke may be prevented by wearing a silk handkerchief in the crown of the hat, by a wet cloth, or by moistened green leaves or grass.

A wounded man is always thirsty; give him cold water, but never spirits, An old soldier drinks and eats as little as possible while marching. For sunstroke remove the collar, loosen the shirt and coat, and continue to throw cold water on the head and spine. For severe cramps, apply hot rocks or pans to the feet and hot fomentations to the stomach.

Men should keep the hair of the head closely cut and the

scalp plentifully washed in cold water every morning. The feet should be washed every night, which will prevent chafing and blistering, and it is the duty of the officers to see that the men properly police themselves and keep clean.

Poisons. For poisonous acids, such as nitric, oxalic, muriatic, or sulphuric acid, avoid emetics. For nitrate of silver give plenty of salt water, followed by barley water or gruel. For strychnine, narcotic poisons, opium, mushrooms, belladonna, etc., give strong emetics at once, pour cold water on the head, neck, and shoulders, place mustard poultices on the feet and keep the person moving about, giving strong coffee as a stimulant. A charge of gunpowder in a tumblerful of warm water, or soap-suds, will make a good emetic. Poison from the bites of insects should be treated by laying a handkerchief lightly above the wound and apply a caustic; if you have none, burn the wound deeply with an iron heated to a white heat, and use utmost exertion to keep the patient from going to sleep. Administer spirits, for wasp and scorpion stings, extract the sting, and rub acetic acid, the nicotine from a pipe, or chewed tobacco upon the wound.

Wounds. The most universally safe position, after all stunning hurts and wounds, is that of being placed on the back, the head being elevated three or four inches only. *Incised wounds*, such as are made by a sword or knife, should be carefully cleansed, all extraneous substances removed, the edges brought together, adhesive plaster applied, and the muscles nearly relaxed. *Punctured wounds*, such as are made by bayonets, pointed rocks, etc., very often excite inflammation in their vicinity, cause formation of matter under the fascia, and frequently result in hemorrhage. The wounded part should be kept at rest, all subcutaneous oozing of the blood prevented, and an exit made for the discharge. If suppuration sets in, an incision should be made at once in order to let out the pus. Probing in search of extraneous matter is very hurtful. *Lacerated wounds*, such as are inflicted by blunt and obtuse bodies, are invariably attended with severe pains, are slow in healing, and are liable to gangrene. They should be thoroughly cleansed, all foreign bodies removed, and the flaps of torn skin replaced as far as possible. A good poultice and disinfectant should be applied to the wound. *Contused wounds*, such as are produced by any blows without

breaking the skin, should be attended to without delay, the parts restored to the normal state by a few days of rest, and some stimulating liniment applied. For a contusion of the head, apply cold water, administer cathartics, make the diet light, take no stimulants, and remain quiet. For scalp wounds cleanse the exposed surface and replace the torn scalp; the parts will generally heal; if abscesses form they should be evacuated by timely incisions. In treatment of wounds the diet should be carefully attended to. In cases of a wounded lung it is necessary to reduce the patient to nearly a state of starvation. Ice, if procurable, will subdue inflammatory symptoms.

Broken Bones. If the skin is uninjured a broken arm or leg is not apt to prove serious, but great care must be observed not to injure the skin, as, if the broken bones force their way through the flesh, abscesses are apt to form and the parts mortify. If a man have either legs or ribs broken, make a stretcher and so carry him, taking care to keep the stretcher as nearly horizontal as possible. When a man has broken his leg, lay him on the other side, put the broken limb exactly on the sound one, with a little straw between, and tie the two legs together with handkerchiefs. When fractures occur and there are no splints at hand, they must be improvised from such materials as may be found. If the thigh be fractured, a rifle may be used for a splint, passed along outside of the limb and secured by bandages around the leg and ankle. A fracture of the arm may be put up with a bayonet scabbard, or with thin bundles of straw or grass. The forearm should be carefully supported in a sling. In case a severe shock or collapse from pain or nervous fear follows a fracture, a stimulant should be administered.

Bleeding. To know how to arrest bleeding is all-important. If the flow pours or trickles in a steady stream from a wound it is not apt to prove serious, and all that is necessary is to bind the wound tightly with a handkerchief or pieces of lint; but if the blood spurts out at regular intervals and is of a bright red color, an artery is wounded and the patient will bleed to death, unless the bleeding is stopped. Tie a handkerchief or string tightly above the part, put a stick through the knot, and twist it round until the bleeding stops; tie a ligature or pad over the wound, and slightly loosen the

handkerchief. After this keep the wounded limb still, well raised, and cool until the wound is nearly healed.

Blistered Feet. Rub the feet before retiring with spirits mixed with tallow or grease, or soap is good. To keep the feet from blistering, soap the inside of the sock before putting it on, or rub the feet well with soap. If the feet ache, change the socks. If one foot only hurts, turn the sock inside out, and it is an excellent plan to have two pairs of shoes to be worn on alternate days. While on the march, let the men lie down the moment they halt for rest. If corns should bother, soak the feet well in warm water, rub a few drops of sweet oil into the top of the corn, then cut a hole through a small piece of buckskin large enough to receive the corn, and attach it to the toe. At night saturate a small piece of cotton with pure water, having ten per cent of carbolic acid in it, and place over the corn; in the morning the corn can be scraped out with a dull knife.

When exposed to a marshy atmosphere or in the presence of epidemics, invariably filter all the drinking and cooking water and dilute it with spirits; the water should be boiled also.

TABLES.

EXPLANATION OF TABLES.

Table I contains the difference of latitude and departure corresponding to distances not exceeding 300 miles, and for courses to every degree of the compass.

The manner of using this table is explained in the different problems of dead-reckoning.

Table II gives the refraction, dip of the horizon, and the sun's parallax in altitude; the application of these is explained in the text under the definition of each on page 39.

Table III gives the declination of the sun to the nearest minute for every noon at Greenwich from the year 1886 to 1901, and this table will answer for some years beyond that period, without any material error. This declination may be reduced to any other meridian in the following manner: Take from the table the declination of the same date as the local date and mark it + when *north* and − when *south*, and apply a correction equal to the "difference for one hour," multiplied by the hours and part of an hour of the longitude, adding or subtracting the correction as the sign in the table indicates; for a time *after* noon if the longitude is *west*, for a time *before* noon if the longitude is *east*.

EXAMPLE. At a place in longitude 81° 15′ W. on April 15, 1887, find the declination. Longitude 81° 15′ W. = + 5ʰ.42.

Table III.	Dec. + 9° 45′	Diff. one hour +	54″
Corr. for + 5ʰ.42	+ 4 53	Long. +	5.42
Declination	+ 9 49 53.		+ 292.68
		Corr. +	4′ 53″

Had this longitude been *east*, we should get, longitude 81° 15′ E. = − 5ʰ.42.

Table III.	Dec. + 9° 45′	Diff. one hour +	54″
Corr. for − 5ʰ.42	− 4 53	Long. −	5.42
Declination	+ 9 40 07		− 292.68
		Corr. −	4′ 53″

To find the declination for a given mean time at a given place proceed as follows: From the given mean time find the astronomical time, and the corresponding Greenwich date. Take from the table the declination for the nearest preceding mean time date, and the corresponding difference for one hour, noting the sign of each. Multiply the difference for one hour by the hours and parts of an hour of the remaining Greenwich time, and apply the correction according to the signs, adding if they are alike, and subtracting if they are unlike. If the given Greenwich time is nearer a following than a preceding date, it may be convenient to interpolate back from the following date.

EXAMPLE. At a given place in longitude 81° 15′ W. on April 15, 1887, 10 A.M., find the declination.

Local astronomical time $14^d\ 22^h\ 00^m$

Longitude $+\ 5\ 25$

Greenwich mean time $15\ 3\ 25$

Table III.	Dec. $+\ 9°\ 45'$	Diff. one hour $+$	$54''$
Corr. for G. M. T.	$+\ 3.03$	G. M. Time $+$	3.4
Declination	$+\ 9\ 48.03$		$+\ 186.6$
		Corr.	$+\ 3'\ 03''$

Table IV contains the equation of time for every noon at Greenwich, and is to be reduced to any other hour by means of **Table IV*a***. Thus, suppose the equation of time was required for Feb. 21, 1888, at 10 A.M., corresponding to Feb. 20th, 22 hours, Table IV gives the equation of time for Feb. 20th, $14^m\ 00^s$, and for the 21st, $13^m\ 53^s$; the difference between the two is a daily decrease of 7^s. Now enter Table IV*a*, and with 7 at the top and 22 at the side, the corresponding 6 in the column is the number of seconds to subtract from $14^m\ 00^s$ to give the required equation of time, $13^m\ 54^s$. This 6 seconds would have been added had the equation of time been increasing. The equation of time thus found is to be applied to the apparent time, as stated at the head of the column in Table IV. To obtain the apparent time from the mean time, the equation of time is applied opposite to the heading in Table IV.

Table V contains the quantities that are convenient for finding the time, or the total error of the compass, by an altitude of the sun. To find the sine, secant, etc., for the degrees, minutes, and seconds of the date occurring in the problems, look for the degrees at the bottom of the page when

between 45° and 135°, otherwise at the top, the minutes being found in the column marked M., which stands on the side of the page on which the degrees are marked; and if the degrees are found at the top, the names, hour, sine, secant, etc., must also be found at the top; and if the degrees are found at the bottom, the names, hour, sine, secant, etc., must be found at the bottom. Opposite to the minutes will be found the sine, secant, etc., in the columns marked sine, secant, etc., respectively. Now, with the number of seconds in the left-hand column under M., take out the number in the nearest column marked "Diff.," which add to the sine, secant, etc., if increasing, or subtract if decreasing.

Thus, to find the *cosine* of 30° 20′ 20″, with 30° at the top of the page and opposite to 20′ under M. in the column marked *cosine*, will be found 9.93606. Now, with 20″ in the *left* column of M., we find opposite in the nearest column of "Diff." the figure 2 to be subtracted from the cosine as it is decreasing, which gives the correct cosine, 9.93604. Should it be desired to find the degrees, minutes, and seconds corresponding to this cosine, we search in the column of cosines for the nearest figures to those given, which will be in the column under 30°, and opposite to the nearest number in the column M. corresponding to 30, will be found 20. Take the difference between the given number and the nearest in the column, which is 2. Now, with this 2, look in the nearest column of "Diff.," and as there are several numbers marked 2, take the middle one, opposite to which, in the left-hand column under M., will be found 16 or 30° 20′ 16″, sufficiently near for all practicable purposes.

The method of finding the hours, minutes, and seconds corresponding to the sine, etc., is fully given in the text on finding the longitude.

Table I.

DIFFERENCE OF LATITUDE AND DEPARTURE,

1°–45°.

DIFFERENCE OF LATITUDE AND DEPARTURE FOR 1°.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	1.0	0.0	61	61.0	1.1	121	121.0	2.1	181	181.0	3.2	241	241.0	4.2
2	2.0	0.0	62	62.0	1.1	22	122.0	2.1	82	182.0	3.2	42	242.0	4.2
3	3.0	0.1	63	63.0	1.1	23	123.0	2.1	83	183.0	3.2	43	243.0	4.2
4	4.0	0.1	64	64.0	1.1	24	124.0	2.2	84	184.0	3.2	44	244.0	4.3
5	5.0	0.1	65	65.0	1.1	25	125.0	2.2	85	185.0	3.2	45	245.0	4.3
6	6.0	0.1	66	66.0	1.2	26	126.0	2.2	86	186.0	3.2	46	246.0	4.3
7	7.0	0.1	67	67.0	1.2	27	127.0	2.2	87	187.0	3.3	47	247.0	4.3
8	8.0	0.1	68	68.0	1.2	28	128.0	2.2	88	188.0	3.3	48	248.0	4.3
9	9.0	0.2	69	69.0	1.2	29	129.0	2.3	89	189.0	3.3	49	249.0	4.3
10	10.0	0.2	70	70.0	1.2	30	130.0	2.3	90	190.0	3.3	50	250.0	4.4
11	11.0	0.2	71	71.0	1.2	131	131.0	2.3	191	191.0	3.3	251	251.0	4.4
12	12.0	0.2	72	72.0	1.3	32	132.0	2.3	92	192.0	3.4	52	252.0	4.4
13	13.0	0.2	73	73.0	1.3	33	133.0	2.3	93	193.0	3.4	53	253.0	4.4
14	14.0	0.2	74	74.0	1.3	34	134.0	2.3	94	194.0	3.4	54	254.0	4.4
15	15.0	0.3	75	75.0	1.3	35	135.0	2.4	95	195.0	3.4	55	255.0	4.5
16	16.0	0.3	76	76.0	1.3	36	136.0	2.4	96	196.0	3.4	56	256.0	4.5
17	17.0	0.3	77	77.0	1.3	37	137.0	2.4	97	197.0	3.4	57	257.0	4.5
18	18.0	0.3	78	78.0	1.4	38	138.0	2.4	98	198.0	3.5	58	258.0	4.5
19	19.0	0.3	79	79.0	1.4	39	139.0	2.4	99	199.0	3.5	59	259.0	4.5
20	20.0	0.3	80	80.0	1.4	40	140.0	2.4	200	200.0	3.5	60	260.0	4.5
21	21.0	0.4	81	81.0	1.4	141	141.0	2.5	201	201.0	3.5	261	261.0	4.6
22	22.0	0.4	82	82.0	1.4	42	142.0	2.5	02	202.0	3.5	62	262.0	4.6
23	23.0	0.4	83	83.0	1.4	43	143.0	2.5	03	203.0	3.5	63	263.0	4.6
24	24.0	0.4	84	84.0	1.5	44	144.0	2.5	04	204.0	3.6	64	264.0	4.6
25	25.0	0.4	85	85.0	1.5	45	145.0	2.5	05	205.0	3.6	65	265.0	4.6
26	26.0	0.5	86	86.0	1.5	46	146.0	2.5	06	206.0	3.6	66	266.0	4.6
27	27.0	0.5	87	87.0	1.5	47	147.0	2.6	07	207.0	3.6	67	267.0	4.7
28	28.0	0.5	88	88.0	1.5	48	148.0	2.6	08	208.0	3.6	68	268.0	4.7
29	29.0	0.5	89	89.0	1.6	49	149.0	2.6	09	209.0	3.6	69	269.0	4.7
30	30.0	0.5	90	90.0	1.6	50	150.0	2.6	10	210.0	3.7	70	270.0	4.7
31	31.0	0.5	91	91.0	1.6	151	151.0	2.6	211	211.0	3.7	271	271.0	4.7
32	32.0	0.6	92	92.0	1.6	52	152.0	2.7	12	212.0	3.7	72	272.0	4.7
33	33.0	0.6	93	93.0	1.6	53	153.0	2.7	13	213.0	3.7	73	273.0	4.8
34	34.0	0.6	94	94.0	1.6	54	154.0	2.7	14	214.0	3.7	74	274.0	4.8
35	35.0	0.6	95	95.0	1.7	55	155.0	2.7	15	215.0	3.8	75	275.0	4.8
36	36.0	0.6	96	96.0	1.7	56	156.0	2.7	16	216.0	3.8	76	276.0	4.8
37	37.0	0.6	97	97.0	1.7	57	157.0	2.7	17	217.0	3.8	77	277.0	4.8
38	38.0	0.7	98	98.0	1.7	58	158.0	2.8	18	218.0	3.8	78	278.0	4.9
39	39.0	0.7	99	99.0	1.7	59	159.0	2.8	19	219.0	3.8	79	279.0	4.9
40	40.0	0.7	100	100.0	1.7	60	160.0	2.8	20	220.0	3.8	80	280.0	4.9
41	41.0	0.7	101	101.0	1.8	161	161.0	2.8	221	221.0	3.9	281	281.0	4.9
42	42.0	0.7	02	102.0	1.8	62	162.0	2.8	22	222.0	3.9	82	282.0	4.9
43	43.0	0.8	03	103.0	1.8	63	163.0	2.8	23	223.0	3.9	83	283.0	4.9
44	44.0	0.8	04	104.0	1.8	64	164.0	2.9	24	224.0	3.9	84	284.0	5.0
45	45.0	0.8	05	105.0	1.8	65	165.0	2.9	25	225.0	3.9	85	285.0	5.0
46	46.0	0.8	06	106.0	1.8	66	166.0	2.9	26	226.0	3.9	86	286.0	5.0
47	47.0	0.8	07	107.0	1.9	67	167.0	2.9	27	227.0	4.0	87	287.0	5.0
48	48.0	0.8	08	108.0	1.9	68	168.0	2.9	28	228.0	4.0	88	288.0	5.0
49	49.0	0.9	09	109.0	1.9	69	169.0	2.9	29	229.0	4.0	89	289.0	5.0
50	50.0	0.9	10	110.0	1.9	70	170.0	3.0	30	230.0	4.0	90	290.0	5.1
51	51.0	0.9	111	111.0	1.9	171	171.0	3.0	231	231.0	4.0	291	291.0	5.1
52	52.0	0.9	12	112.0	2.0	72	172.0	3.0	32	232.0	4.0	92	292.0	5.1
53	53.0	0.9	13	113.0	2.0	73	173.0	3.0	33	233.0	4.1	93	293.0	5.1
54	54.0	0.9	14	114.0	2.0	74	174.0	3.0	34	234.0	4.1	94	294.0	5.1
55	55.0	1.0	15	115.0	2.0	75	175.0	3.1	35	235.0	4.1	95	295.0	5.1
56	56.0	1.0	16	116.0	2.0	76	176.0	3.1	36	236.0	4.1	96	296.0	5.2
57	57.0	1.0	17	117.0	2.0	77	177.0	3.1	37	237.0	4.1	97	297.0	5.2
58	58.0	1.0	18	118.0	2.1	78	178.0	3.1	38	238.0	4.2	98	298.0	5.2
59	59.0	1.0	19	119.0	2.1	79	179.0	3.1	39	239.0	4.2	99	299.0	5.2
60	60.0	1.0	20	120.0	2.1	80	180.0	3.1	40	240.0	4.2	300	300.0	5.2

Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep	Lat.	Dist.	Dep.	Lat.	Dist.	Dep	Lat.

[For 89 Degrees.

DIFFERENCE OF LATITUDE AND DEPARTURE FOR 2°.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	1.0	0.0	61	61.0	2.1	121	120.9	4.2	181	180.9	6.3	241	240.9	8.4
2	2.0	0.1	62	62.0	2.2	22	121.9	4.3	82	181.9	6.4	42	241.9	8.4
3	3.0	0.1	63	63.0	2.2	23	122.9	4.3	83	182.9	6.4	43	242.9	8.5
4	4.0	0.1	64	64.0	2.2	24	123.9	4.3	84	183.9	6.4	44	243.9	8.5
5	5.0	0.2	65	65.0	2.3	25	124.9	4.4	85	184.9	6.5	45	244.9	8.6
6	6.0	0.2	66	66.0	2.3	26	125.9	4.4	86	185.9	6.5	46	245.9	8.6
7	7.0	0.2	67	67.0	2.3	27	126.9	4.4	87	186.9	6.5	47	246.8	8.6
8	8.0	0.3	68	68.0	2.4	28	127.9	4.5	88	187.9	6.6	48	247.8	8.7
9	9.0	0.3	69	69.0	2.4	29	128.9	4.5	89	188.9	6.6	49	248.8	8.7
10	10.0	0.3	70	70.0	2.4	30	129.9	4.5	90	189.9	6.6	50	249.8	8.7
11	11.0	0.4	71	71.0	2.5	131	130.9	4.6	191	190.9	6.7	251	250.8	8.8
12	12.0	0.4	72	72.0	2.5	32	131.9	4.6	92	191.9	6.7	52	251.8	8.8
13	13.0	0.5	73	73.0	2.5	33	132.9	4.6	93	192.9	6.7	53	252.8	8.8
14	14.0	0.5	74	74.0	2.6	34	133.9	4.7	94	193.9	6.8	54	253.8	8.9
15	15.0	0.5	75	75.0	2.6	35	134.9	4.7	95	194.9	6.8	55	254.8	8.9
16	16.0	0.6	76	76.0	2.7	36	135.9	4.7	96	195.9	6.8	56	255.8	8.9
17	17.0	0.6	77	77.0	2.7	37	136.9	4.8	97	196.9	6.9	57	256.8	9.0
18	18.0	0.6	78	78.0	2.7	38	137.9	4.8	98	197.9	6.9	58	257.8	9.0
19	19.0	0.7	79	79.0	2.8	39	138.9	4.9	99	198.9	6.9	59	258.8	9.0
20	20.0	0.7	80	80.0	2.8	40	139.9	4.9	200	199.9	7.0	60	259.8	9.1
21	21.0	0.7	81	81.0	2.8	141	140.9	4.9	201	200.9	7.0	261	260.8	9.1
22	22.0	0.8	82	82.0	2.9	42	141.9	5.0	02	201.9	7.0	62	261.8	9.1
23	23.0	0.8	83	82.9	2.9	43	142.9	5.0	03	202.9	7.1	63	262.8	9.2
24	24.0	0.8	84	83.9	2.9	44	143.9	5.0	04	203.9	7.1	64	263.8	9.2
25	25.0	0.9	85	84.9	3.0	45	144.9	5.1	05	204.9	7.2	65	264.8	9.2
26	26.0	0.9	86	85.9	3.0	46	145.9	5.1	06	205.9	7.2	66	265.8	9.3
27	27.0	0.9	87	86.9	3.0	47	146.9	5.1	07	206.9	7.2	67	266.8	9.3
28	28.0	1.0	88	87.9	3.1	48	147.9	5.2	08	207.9	7.3	68	267.8	9.4
29	29.0	1.0	89	88.9	3.1	49	148.9	5.2	09	208.9	7.3	69	268.8	9.4
30	30.0	1.0	90	89.9	3.1	50	149.9	5.2	10	209.9	7.3	70	269.8	9.4
31	31.0	1.1	91	90.9	3.2	151	150.9	5.3	211	210.9	7.4	271	270.8	9.5
32	32.0	1.1	92	91.9	3.2	52	151.9	5.3	12	211.9	7.4	72	271.8	9.5
33	33.0	1.2	93	92.9	3.2	53	152.9	5.3	13	212.9	7.4	73	272.8	9.5
34	34.0	1.2	94	93.9	3.3	54	153.9	5.4	14	213.9	7.5	74	273.8	9.6
35	35.0	1.2	95	94.9	3.3	55	154.9	5.4	15	214.9	7.5	75	274.8	9.6
36	36.0	1.3	96	95.9	3.4	56	155.9	5.4	16	215.9	7.5	76	275.8	9.6
37	37.0	1.3	97	96.9	3.4	57	156.9	5.5	17	216.9	7.6	77	276.8	9.7
38	38.0	1.3	98	97.9	3.4	58	157.9	5.5	18	217.9	7.6	78	277.8	9.7
39	39.0	1.4	99	98.9	3.5	59	158.9	5.5	19	218.9	7.6	79	278.8	9.7
40	40.0	1.4	100	99.9	3.5	60	159.9	5.6	20	219.9	7.7	80	279.8	9.8
41	41.0	1.4	101	100.9	3.5	161	160.9	5.6	221	220.9	7.7	281	280.8	9.8
42	42.0	1.5	02	101.9	3.6	62	161.9	5.7	22	221.9	7.7	82	281.8	9.8
43	43.0	1.5	03	102.9	3.6	63	162.9	5.7	23	222.9	7.8	83	282.8	9.9
44	44.0	1.5	04	103.9	3.6	64	163.9	5.7	24	223.9	7.8	84	283.8	9.9
45	45.0	1.6	05	104.9	3.7	65	164.9	5.8	25	224.9	7.9	85	284.8	9.9
46	46.0	1.6	06	105.9	3.7	66	165.9	5.8	26	225.9	7.9	86	285.8	10.0
47	47.0	1.6	07	106.9	3.7	67	166.9	5.8	27	226.9	7.9	87	286.8	10.0
48	48.0	1.7	08	107.9	3.8	68	167.9	5.9	28	227.9	8.0	88	287.8	10.1
49	49.0	1.7	09	108.9	3.8	69	168.9	5.9	29	228.9	8.0	89	288.8	10.1
50	50.0	1.7	10	109.9	3.8	70	169.9	5.9	30	229.9	8.0	90	289.8	10.1
51	51.0	1.8	111	110.9	3.9	171	170.9	6.0	231	230.9	8.1	291	290.8	10.2
52	52.0	1.8	12	111.9	3.9	72	171.9	6.0	32	231.9	8.1	92	291.8	10.2
53	53.0	1.8	13	112.9	3.9	73	172.9	6.0	33	232.9	8.1	93	292.8	10.2
54	54.0	1.9	14	113.9	4.0	74	173.9	6.1	34	233.9	8.2	94	293.8	10.3
55	55.0	1.9	15	114.9	4.0	75	174.9	6.1	35	234.9	8.2	95	294.8	10.3
56	56.0	2.0	16	115.9	4.0	76	175.9	6.1	36	235.9	8.2	96	295.8	10.3
57	57.0	2.0	17	116.9	4.1	77	176.9	6.2	37	236.9	8.3	97	296.8	10.4
58	58.0	2.0	18	117.9	4.1	78	177.9	6.2	38	237.9	8.3	98	297.8	10.4
59	59.0	2.1	19	118.9	4.2	79	178.9	6.2	39	238.9	8.3	99	298.8	10.4
60	60.0	2.1	20	119.9	4.2	80	179.9	6.3	40	239.9	8.4	300	299.8	10.5

Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

[For 88 Degrees.

DIFFERENCE OF LATITUDE AND DEPARTURE FOR 3°.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	1.0	0.1	61	60.9	3.2	121	120.8	6.3	181	180.8	9.5	241	240.7	12.6
2	2.0	0.1	62	61.9	3.2	22	121.8	6.4	82	181.8	9.5	42	241.7	12.7
3	3.0	0.2	63	62.9	3.3	23	122.8	6.4	83	182.7	9.6	43	242.7	12.7
4	4.0	0.2	64	63.9	3.3	24	123.8	6.5	84	183.7	9.6	44	243.7	12.8
5	5.0	0.3	65	64.9	3.4	25	124.8	6.5	85	184.7	9.7	45	244.7	12.8
6	6.0	0.3	66	65.9	3.5	26	125.8	6.6	86	185.7	9.7	46	245.7	12.9
7	7.0	0.4	67	66.9	3.5	27	126.8	6.6	87	186.7	9.8	47	246.7	12.9
8	8.0	0.4	68	67.9	3.6	28	127.8	6.7	88	187.7	9.8	48	247.7	13.0
9	9.0	0.5	69	68.9	3.6	29	128.8	6.8	89	188.7	9.9	49	248.7	13.0
10	10.0	0.5	70	69.9	3.7	30	129.8	6.8	90	189.7	9.9	50	249.7	13.1
11	11.0	0.6	71	70.9	3.7	131	130.8	6.9	191	190.7	10.0	251	250.7	13.1
12	12.0	0.6	72	71.9	3.8	32	131.8	6.9	92	191.7	10.0	52	251.7	13.2
13	13.0	0.7	73	72.9	3.8	33	132.8	7.0	93	192.7	10.1	53	252.7	13.2
14	14.0	0.7	74	73.9	3.9	34	133.8	7.0	94	193.7	10.2	54	253.7	13.3
15	15.0	0.8	75	74.9	3.9	35	134.8	7.1	95	194.7	10.2	55	254.7	13.3
16	16.0	0.8	76	75.9	4.0	36	135.8	7.1	96	195.7	10.3	56	255.6	13.4
17	17.0	0.9	77	76.9	4.0	37	136.8	7.2	97	196.7	10.3	57	256.6	13.5
18	18.0	0.9	78	77.9	4.1	38	137.8	7.2	98	197.7	10.4	58	257.6	13.5
19	19.0	1.0	79	78.9	4.1	39	138.8	7.3	99	198.7	10.4	59	258.6	13.6
20	20.0	1.0	80	79.9	4.2	40	139.8	7.3	200	199.7	10.5	60	259.6	13.6
21	21.0	1.1	81	80.9	4.2	141	140.8	7.4	201	200.7	10.5	261	260.6	13.7
22	22.0	1.2	82	81.9	4.3	42	141.8	7.4	02	201.7	10.6	62	261.6	13.7
23	23.0	1.2	83	82.9	4.3	43	142.8	7.5	03	202.7	10.6	63	262.6	13.8
24	24.0	1.3	84	83.9	4.4	44	143.8	7.5	04	203.7	10.7	64	263.6	13.8
25	25.0	1.3	85	84.9	4.4	45	144.8	7.6	05	204.7	10.7	65	264.6	13.9
26	26.0	1.4	86	85.9	4.5	46	145.8	7.6	06	205.7	10.8	66	265.6	13.9
27	27.0	1.4	87	86.9	4.6	47	146.8	7.7	07	206.7	10.8	67	266.6	14.0
28	28.0	1.5	88	87.9	4.6	48	147.8	7.7	08	207.7	10.9	68	267.6	14.0
29	29.0	1.5	89	88.9	4.7	49	148.8	7.8	09	208.7	10.9	69	268.6	14.1
30	30.0	1.6	90	89.9	4.7	50	149.8	7.9	10	209.7	11.0	70	269.6	14.1
31	31.0	1.6	91	90.9	4.8	151	150.8	7.9	211	210.7	11.0	271	270.6	14.2
32	32.0	1.7	92	91.9	4.8	52	151.8	8.0	12	211.7	11.1	72	271.6	14.2
33	33.0	1.7	93	92.9	4.9	53	152.8	8.0	13	212.7	11.1	73	272.6	14.3
34	34.0	1.8	94	93.9	4.9	54	153.8	8.1	14	213.7	11.2	74	273.6	14.3
35	35.0	1.8	95	94.9	5.0	55	154.8	8.1	15	214.7	11.3	75	274.6	14.4
36	36.0	1.9	96	95.9	5.0	56	155.8	8.2	16	215.7	11.3	76	275.6	14.4
37	36.9	1.9	97	96.9	5.1	57	156.8	8.2	17	216.7	11.4	77	276.6	14.5
38	37.9	2.0	98	97.9	5.1	58	157.8	8.3	18	217.7	11.4	78	277.6	14.5
39	38.9	2.0	99	98.9	5.2	59	158.8	8.3	19	218.7	11.5	79	278.6	14.6
40	39.9	2.1	100	99.9	5.2	60	159.8	8.4	20	219.7	11.5	80	279.6	14.7
41	40.9	2.1	101	100.9	5.3	161	160.8	8.4	221	220.7	11.6	281	280.6	14.7
42	41.9	2.2	02	101.9	5.3	62	161.8	8.5	22	221.7	11.6	82	281.6	14.8
43	42.9	2.3	03	102.9	5.4	63	162.8	8.5	23	222.7	11.7	83	282.6	14.8
44	43.9	2.3	04	103.9	5.4	64	163.8	8.6	24	223.7	11.7	84	283.6	14.9
45	44.9	2.4	05	104.9	5.5	65	164.8	8.6	25	224.7	11.8	85	284.6	14.9
46	45.9	2.4	06	105.9	5.5	66	165.8	8.7	26	225.7	11.8	86	285.6	15.0
47	46.9	2.5	07	106.9	5.6	67	166.8	8.7	27	226.7	11.9	87	286.6	15.0
48	47.9	2.5	08	107.9	5.7	68	167.8	8.8	28	227.7	11.9	88	287.6	15.1
49	48.9	2.6	09	108.9	5.7	69	168.8	8.8	29	228.7	12.0	89	288.6	15.1
50	49.9	2.6	10	109.8	5.8	70	169.8	8.9	30	229.7	12.0	90	289.6	15.2
51	50.9	2.7	111	110.8	5.8	171	170.8	8.9	231	230.7	12.1	291	290.6	15.2
52	51.9	2.7	12	111.8	5.9	72	171.8	9.0	32	231.7	12.1	92	291.6	15.3
53	52.9	2.8	13	112.8	5.9	73	172.8	9.1	33	232.7	12.2	93	292.6	15.3
54	53.9	2.8	14	113.8	6.0	74	173.8	9.1	34	233.7	12.2	94	293.6	15.4
55	54.9	2.9	15	114.8	6.0	75	174.8	9.2	35	234.7	12.3	95	294.6	15.4
56	55.9	2.9	16	115.8	6.1	76	175.8	9.2	36	235.7	12.4	96	295.6	15.5
57	56.9	3.0	17	116.8	6.1	77	176.8	9.3	37	236.7	12.4	97	296.6	15.5
58	57.9	3.0	18	117.8	6.2	78	177.8	9.3	38	237.7	12.5	98	297.6	15.6
59	58.9	3.1	19	118.8	6.2	79	178.8	9.4	39	238.7	12.5	99	298.6	15.6
60	59.9	3.1	20	119.8	6.3	80	179.8	9.4	40	239.7	12.6	300	299.6	15.7

Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

[For 87 Degrees.

DIFFERENCE OF LATITUDE AND DEPARTURE FOR 4°.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	1.0	0.1	61	60.9	4.3	121	120.7	8.4	181	180.6	12.6	241	240.4	16.8
2	2.0	0.1	62	61.8	4.3	22	121.7	8.5	82	181.6	12.7	42	241.4	16.9
3	3.0	0.2	63	62.8	4.4	23	122.7	8.6	83	182.6	12.8	43	242.4	17.0
4	4.0	0.3	64	63.8	4.5	24	123.7	8.6	84	183.6	12.8	44	243.4	17.0
5	5.0	0.3	65	64.8	4.5	25	124.7	8.7	85	184.5	12.9	45	244.4	17.1
6	6.0	0.4	66	65.8	4.6	26	125.7	8.8	86	185.5	13.0	46	245.4	17.2
7	7.0	0.5	67	66.8	4.7	27	126.7	8.9	87	186.5	13.0	47	246.4	17.2
8	8.0	0.6	68	67.8	4.7	28	127.7	8.9	88	187.5	13.1	48	247.4	17.3
9	9.0	0.6	69	68.8	4.8	29	128.7	9.0	89	188.5	13.2	49	248.4	17.4
10	10.0	0.7	70	69.8	4.9	30	129.7	9.1	90	189.5	13.3	50	249.4	17.4
11	11.0	0.8	71	70.8	5.0	131	130.7	9.1	191	190.5	13.3	251	250.4	17.5
12	12.0	0.8	72	71.8	5.0	32	131.7	9.2	92	191.5	13.4	52	251.4	17.6
13	13.0	0.9	73	72.8	5.1	33	132.7	9.3	93	192.5	13.5	53	252.4	17.6
14	14.0	1.0	74	73.8	5.2	34	133.7	9.3	94	193.5	13.5	54	253.4	17.7
15	15.0	1.0	75	74.8	5.2	35	134.7	9.4	95	194.5	13.6	55	254.4	17.8
16	16.0	1.1	76	75.8	5.3	36	135.7	9.5	96	195.5	13.7	56	255.4	17.9
17	17.0	1.2	77	76.8	5.4	37	136.7	9.6	97	196.5	13.7	57	256.4	17.9
18	18.0	1.3	78	77.8	5.4	38	137.7	9.6	98	197.5	13.8	58	257.4	18.0
19	19.0	1.3	79	78.8	5.5	39	138.7	9.7	99	198.5	13.9	59	258.4	18.1
20	20.0	1.4	80	79.8	5.6	40	139.7	9.8	200	199.5	14.0	60	259.4	18.1
21	20.9	1.5	81	80.8	5.7	141	140.7	9.8	201	200.5	14.0	261	260.4	18.2
22	21.9	1.5	82	81.8	5.7	42	141.7	9.9	02	201.5	14.1	62	261.4	18.3
23	22.9	1.6	83	82.8	5.8	43	142.7	10.0	03	202.5	14.2	63	262.4	18.3
24	23.9	1.7	84	83.8	5.9	44	143.6	10.0	04	203.5	14.2	64	263.4	18.4
25	24.9	1.7	85	84.8	5.9	45	144.6	10.1	05	204.5	14.3	65	264.4	18.5
26	25.9	1.8	86	85.8	6.0	46	145.6	10.2	06	205.5	14.4	66	265.4	18.6
27	26.9	1.9	87	86.8	6.1	47	146.6	10.3	07	206.5	14.4	67	266.3	18.6
28	27.9	2.0	88	87.8	6.1	48	147.6	10.3	08	207.5	14.5	68	267.3	18.7
29	28.9	2.0	89	88.8	6.2	49	148.6	10.4	09	208.5	14.6	69	268.3	18.8
30	29.9	2.1	90	89.8	6.3	50	149.6	10.5	10	209.5	14.6	70	269.3	18.8
31	30.9	2.2	91	90.8	6.3	151	150.6	10.5	211	210.5	14.7	271	270.3	18.9
32	31.9	2.2	92	91.8	6.4	52	151.6	10.6	12	211.5	14.8	72	271.3	19.0
33	32.9	2.3	93	92.8	6.5	53	152.6	10.7	13	212.5	14.9	73	272.3	19.0
34	33.9	2.4	94	93.8	6.6	54	153.6	10.7	14	213.5	14.9	74	273.3	19.1
35	34.9	2.5	95	94.8	6.6	55	154.6	10.8	15	214.5	15.0	75	274.3	19.2
36	35.9	2.5	96	95.8	6.7	56	155.6	10.9	16	215.5	15.1	76	275.3	19.3
37	36.9	2.6	97	96.8	6.8	57	156.6	11.0	17	216.5	15.1	77	276.3	19.3
38	37.9	2.7	98	97.8	6.8	58	157.6	11.0	18	217.5	15.2	78	277.3	19.4
39	38.9	2.7	99	98.8	6.9	59	158.6	11.1	19	218.5	15.3	79	278.3	19.5
40	39.9	2.8	100	99.8	7.0	60	159.6	11.2	20	219.5	15.3	80	279.3	19.5
41	40.9	2.9	101	100.8	7.0	161	160.6	11.2	221	220.5	15.4	281	280.3	19.6
42	41.9	2.9	02	101.8	7.1	62	161.6	11.3	22	221.5	15.5	82	281.3	19.7
43	42.9	3.0	03	102.7	7.2	63	162.6	11.4	23	222.5	15.6	83	282.3	19.7
44	43.9	3.1	04	103.7	7.3	64	163.6	11.4	24	223.5	15.6	84	283.3	19.8
45	44.9	3.1	05	104.7	7.3	65	164.6	11.5	25	224.5	15.7	85	284.3	19.9
46	45.9	3.2	06	105.7	7.4	66	165.6	11.6	26	225.4	15.8	86	285.3	20.0
47	46.9	3.3	07	106.7	7.5	67	166.6	11.6	27	226.4	15.8	87	286.3	20.0
48	47.9	3.3	08	107.6	7.5	68	167.6	11.7	28	227.4	15.9	88	287.3	20.1
49	48.9	3.4	09	108.7	7.6	69	168.6	11.8	29	228.4	16.0	89	288.3	20.2
50	49.9	3.5	10	109.7	7.7	70	169.6	11.9	30	229.4	16.0	90	289.3	20.2
51	50.9	3.6	111	110.7	7.7	171	170.6	11.9	231	230.4	16.1	291	290.3	20.3
52	51.9	3.6	12	111.7	7.8	72	171.6	12.0	32	231.4	16.2	92	291.3	20.4
53	52.9	3.7	13	112.7	7.9	73	172.6	12.1	33	232.4	16.3	93	292.3	20.4
54	53.9	3.8	14	113.7	8.0	74	173.6	12.1	34	233.4	16.3	94	293.3	20.5
55	54.9	3.8	15	114.7	8.0	75	174.6	12.2	35	234.4	16.4	95	294.3	20.6
56	55.9	3.9	16	115.7	8.1	76	175.6	12.3	36	235.4	16.5	96	295.3	20.6
57	56.9	4.0	17	116.7	8.2	77	176.6	12.3	37	236.4	16.5	97	296.3	20.7
58	57.9	4.0	18	117.7	8.2	78	177.6	12.4	38	237.4	16.6	98	297.3	20.8
59	58.9	4.1	19	118.7	8.3	79	178.6	12.5	39	238.4	16.7	99	298.3	20.9
60	59.9	4.2	20	119.7	8.4	80	179.6	12.6	40	239.4	16.7	300	299.3	20.9

Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

[For 86 Degrees.

DIFFERENCE OF LATITUDE AND DEPARTURE FOR 5°.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	1.0	0.1	61	60.8	5.3	121	120.5	10.5	181	180.3	15.8	241	240.1	21.0
2	2.0	0.2	62	61.8	5.4	122	121.5	10.6	182	181.3	15.9	42	241.1	21.1
3	3.0	0.3	63	62.8	5.5	23	122.5	10.7	83	182.3	15.9	43	242.1	21.2
4	4.0	0.3	64	63.8	5.6	24	123.5	10.8	84	183.3	16.0	44	243.1	21.3
5	5.0	0.4	65	64.8	5.7	25	124.5	10.9	85	184.3	16.1	45	244.1	21.4
6	6.0	0.5	66	65.7	5.8	26	125.5	11.0	86	185.3	16.2	46	245.1	21.4
7	7.0	0.6	67	66.7	5.8	27	126.5	11.1	87	186.3	16.3	47	246.1	21.5
8	8.0	0.7	68	67.7	5.9	28	127.5	11.2	88	187.3	16.4	48	247.1	21.6
9	9.0	0.8	69	68.7	6.0	29	128.5	11.2	89	188.3	16.5	49	248.1	21.7
10	10.0	0.9	70	69.7	6.1	30	129.5	11.3	90	189.3	16.6	50	249.0	21.8
11	11.0	1.0	71	70.7	6.2	131	130.5	11.4	191	190.3	16.6	251	250.0	21.9
12	12.0	1.0	72	71.7	6.3	32	131.5	11.5	92	191.3	16.7	52	251.0	22.0
13	13.0	1.1	73	72.7	6.4	33	132.5	11.6	93	192.3	16.8	53	252.0	22.1
14	13.9	1.2	74	73.7	6.4	34	133.5	11.7	94	193.3	16.9	54	253.0	22.1
15	14.9	1.3	75	74.7	6.5	35	134.5	11.8	95	194.3	17.0	55	254.0	22.2
16	15.9	1.4	76	75.7	6.6	36	135.5	11.9	96	195.3	17.1	56	255.0	22.3
17	16.9	1.5	77	76.7	6.7	37	136.5	11.9	97	196.3	17.2	57	256.0	22.4
18	17.9	1.6	78	77.7	6.8	38	137.5	12.0	98	197.2	17.3	58	257.0	22.5
19	18.9	1.7	79	78.7	6.9	39	138.5	12.1	99	198.2	17.3	59	258.0	22.6
20	19.9	1.7	80	79.7	7.0	40	139.5	12.2	200	199.2	17.4	60	259.0	22.7
21	20.9	1.8	81	80.7	7.1	141	140.5	12.3	201	200.2	17.5	261	260.0	22.7
22	21.9	1.9	82	81.7	7.1	42	141.5	12.4	02	201.2	17.6	62	261.0	22.8
23	22.9	2.0	83	82.7	7.2	43	142.5	12.5	03	202.2	17.7	63	262.0	22.9
24	23.9	2.1	84	83.7	7.3	44	143.5	12.6	04	203.2	17.8	64	263.0	23.0
25	24.9	2.2	85	84.7	7.4	45	144.4	12.6	05	204.2	17.9	65	264.0	23.1
26	25.9	2.3	86	85.7	7.5	46	145.4	12.7	06	205.2	18.0	66	265.0	23.2
27	26.9	2.4	87	86.7	7.6	47	146.4	12.8	07	206.2	18.0	67	266.0	23.3
28	27.9	2.4	88	87.7	7.7	48	147.4	12.9	08	207.2	18.1	68	267.0	23.4
29	28.9	2.5	89	88.7	7.8	49	148.4	13.0	09	208.2	18.2	69	268.0	23.4
30	29.9	2.6	90	89.7	7.8	50	149.4	13.1	10	209.2	18.3	70	269.0	23.5
31	30.9	2.7	91	90.7	7.9	151	150.4	13.2	211	210.2	18.4	271	270.0	23.6
32	31.9	2.8	92	91.6	8.0	52	151.4	13.2	12	211.2	18.5	72	271.0	23.7
33	32.9	2.9	93	92.6	8.1	53	152.4	13.3	13	212.2	18.6	73	272.0	23.8
34	33.9	3.0	94	93.6	8.2	54	153.4	13.4	14	213.2	18.7	74	273.0	23.9
35	34.9	3.1	95	94.6	8.3	55	154.4	13.5	15	214.2	18.7	75	274.0	24.0
36	35.9	3.1	96	95.6	8.4	56	155.4	13.6	16	215.2	18.8	76	274.9	24.1
37	36.9	3.2	97	96.6	8.5	57	156.4	13.7	17	216.2	18.9	77	275.9	24.1
38	37.9	3.3	98	97.6	8.5	58	157.4	13.8	18	217.2	19.0	78	276.9	24.2
39	38.9	3.4	99	98.6	8.6	59	158.4	13.9	19	218.2	19.1	79	277.9	24.3
40	39.8	3.5	100	99.6	8.7	60	159.4	13.9	20	219.2	19.2	80	278.9	24.4
41	40.8	3.6	101	100.6	8.8	161	160.4	14.0	221	220.2	19.3	281	279.9	24.5
42	41.8	3.7	02	101.6	8.9	62	161.4	14.1	22	221.2	19.3	82	280.9	24.6
43	42.8	3.7	03	102.6	9.0	63	162.4	14.2	23	222.2	19.4	83	281.9	24.7
44	43.8	3.8	04	103.6	9.1	64	163.4	14.3	24	223.1	19.5	84	282.9	24.8
45	44.8	3.9	05	104.6	9.2	65	164.4	14.4	25	224.1	19.6	85	283.9	24.8
46	45.8	4.0	06	105.6	9.2	66	165.4	14.5	26	225.1	19.7	86	284.9	24.9
47	46.8	4.1	07	106.6	9.3	67	166.4	14.6	27	226.1	19.8	87	285.9	25.0
48	47.8	4.2	08	107.6	9.4	68	167.4	14.6	28	227.1	19.9	88	286.9	25.1
49	48.8	4.3	09	108.6	9.5	69	168.4	14.7	29	228.1	20.0	89	287.9	25.2
50	49.8	4.4	10	109.6	9.6	70	169.4	14.8	30	229.1	20.0	90	288.9	25.3
51	50.8	4.4	111	110.6	9.7	171	170.3	14.9	231	230.1	20.1	291	289.9	25.4
52	51.8	4.5	12	111.6	9.8	72	171.3	15.0	32	231.1	20.2	92	290.9	25.4
53	52.8	4.6	13	112.6	9.8	73	172.3	15.1	33	232.1	20.3	93	291.9	25.5
54	53.8	4.7	14	113.6	9.9	74	173.3	15.2	34	233.1	20.4	94	292.9	25.6
55	54.8	4.8	15	114.6	10.0	75	174.3	15.3	35	234.1	20.5	95	293.9	25.7
56	55.8	4.9	16	115.6	10.1	76	175.3	15.3	36	235.1	20.6	96	294.9	25.8
57	56.8	5.0	17	116.6	10.2	77	176.3	15.4	37	236.1	20.7	97	295.9	25.9
58	57.8	5.1	18	117.6	10.3	78	177.3	15.5	38	237.1	20.7	98	296.9	26.0
59	58.8	5.1	19	118.5	10.4	79	178.3	15.6	39	238.1	20.8	99	297.9	26.1
60	59.8	5.2	20	119.5	10.5	80	179.3	15.7	40	239.1	20.9	300	298.9	26.1

Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

[For 85 Degrees.

DIFFERENCE OF LATITUDE AND DEPARTURE FOR 6°.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	1.0	0.1	61	60.7	6.4	121	120.3	12.6	181	180.0	18.9	241	239.7	25.2
2	2.0	0.2	62	61.7	6.5	122	121.3	12.8	182	181.0	19.0	242	240.7	25.3
3	3.0	0.3	63	62.7	6.6	123	122.3	12.9	183	182.0	19.1	243	241.7	25.4
4	4.0	0.4	64	63.6	6.7	124	123.3	13.0	184	183.0	19.2	244	242.7	25.5
5	5.0	0.5	65	64.6	6.8	25	124.3	13.1	85	184.0	19.3	45	243.7	25.6
6	6.0	0.6	66	65.6	6.9	26	125.3	13.2	86	185.0	19.4	46	244.7	25.7
7	7.0	0.7	67	66.6	7.0	27	126.3	13.3	87	186.0	19.5	47	245.6	25.8
8	8.0	0.8	68	67.6	7.1	28	127.3	13.4	88	187.0	19.7	48	246.6	25.9
9	9.0	0.9	69	68.0	7.2	29	128.3	13.5	89	188.0	19.8	49	247.6	26.0
10	9.9	1.0	70	69.6	7.3	30	129.3	13.6	90	189.0	19.9	50	248.6	26.1
11	10.9	1.1	71	70.6	7.4	131	130.3	13.7	191	190.0	20.0	251	249.6	26.2
12	11.9	1.3	72	71.6	7.5	32	131.3	13.8	92	190.9	20.1	52	250.6	26.3
13	12.9	1.4	73	72.6	7.6	33	132.3	13.9	93	191.9	20.2	53	251.6	26.4
14	13.9	1.5	74	73.6	7.7	34	133.3	14.0	94	192.9	20.3	54	252.6	26.6
15	14.9	1.6	75	74.6	7.8	35	134.3	14.1	95	193.9	20.4	55	253.6	26.7
16	15.9	1.7	76	75.6	7.9	36	135.3	14.2	96	194.9	20.5	56	254.6	26.8
17	16.9	1.8	77	76.6	8.0	37	136.2	14.3	97	195.9	20.6	57	255.6	26.9
18	17.9	1.9	78	77.6	8.2	38	137.2	14.4	98	196.9	20.7	58	256.6	27.0
19	18.9	2.0	79	78.6	8.3	39	138.2	14.5	99	197.9	20.8	59	257.6	27.1
20	19.9	2.1	80	79.6	8.4	40	139.2	14.6	200	198.9	20.9	60	258.6	27.2
21	20.9	2.2	81	80.6	8.5	141	140.2	14.7	201	199.9	21.0	261	259.6	27.3
22	21.9	2.3	82	81.6	8.6	42	141.2	14.8	02	200.9	21.1	62	260.6	27.4
23	22.9	2.4	83	82.5	8.7	43	142.2	14.9	03	201.9	21.2	63	261.6	27.5
24	23.9	2.5	84	83.5	8.8	44	143.2	15.1	04	202.9	21.3	64	262.6	27.6
25	24.9	2.6	85	84.5	8.9	45	144.2	15.2	05	203.9	21.4	65	263.5	27.7
26	25.9	2.7	86	85.5	9.0	46	145.2	15.3	06	204.9	21.5	66	264.5	27.8
27	26.9	2.8	87	86.5	9.1	47	146.2	15.4	07	205.9	21.6	67	265.5	27.9
28	27.8	2.9	88	87.5	9.2	48	147.2	15.5	08	206.9	21.7	68	266.5	28.0
29	28.8	3.0	89	88.5	9.3	49	148.2	15.6	09	207.9	21.8	69	267.5	28.1
30	29.8	3.1	90	89.5	9.4	50	149.2	15.7	10	208.8	22.0	70	268.5	28.2
31	30.8	3.2	91	90.5	9.5	151	150.2	15.8	211	209.8	22.1	271	269.5	28.3
32	31.8	3.3	92	91.5	9.6	52	151.2	15.9	12	210.8	22.2	72	270.5	28.4
33	32.8	3.4	93	92.5	9.7	53	152.2	16.0	13	211.8	22.3	73	271.5	28.5
34	33.8	3.6	94	93.5	9.8	54	153.2	16.1	14	212.8	22.4	74	272.5	28.6
35	34.8	3.7	95	94.5	9.9	55	154.2	16.2	15	213.8	22.5	75	273.5	28.7
36	35.8	3.8	96	95.5	10.0	56	155.1	16.3	16	214.8	22.6	76	274.5	28.8
37	36.8	3.9	97	96.5	10.1	57	156.1	16.4	17	215.8	22.7	77	275.5	29.0
38	37.8	4.0	98	97.5	10.2	58	157.1	16.5	18	216.8	22.8	78	276.5	29.1
39	38.8	4.1	99	98.5	10.3	59	158.1	16.6	19	217.8	22.9	79	277.5	29.2
40	39.8	4.2	100	99.5	10.5	60	159.1	16.7	20	218.8	23.0	80	278.5	29.3
41	40.8	4.3	101	100.4	10.6	161	160.1	16.8	221	219.8	23.1	281	279.5	29.4
42	41.8	4.4	02	101.4	10.7	62	161.1	16.9	22	220.8	23.2	82	280.5	29.5
43	42.8	4.5	03	102.4	10.8	63	162.1	17.0	23	221.8	23.3	83	281.4	29.6
44	43.8	4.6	04	103.4	10.9	64	163.1	17.1	24	222.8	23.4	84	282.4	29.7
45	44.8	4.7	05	104.4	11.0	65	164.1	17.2	25	223.8	23.5	85	283.4	29.8
46	45.7	4.8	06	105.4	11.1	66	165.1	17.4	26	224.8	23.6	86	284.4	29.9
47	46.7	4.9	07	106.4	11.2	67	166.1	17.5	27	225.8	23.7	87	285.4	30.0
48	47.7	5.0	08	107.4	11.3	68	167.1	17.6	28	226.8	23.8	88	286.4	30.1
49	48.7	5.1	09	108.4	11.4	69	168.1	17.7	29	227.7	23.9	89	287.4	30.2
50	49.7	5.2	10	109.4	11.5	70	169.1	17.8	30	228.7	24.0	90	288.4	30.3
51	50.7	5.3	111	110.4	11.6	171	170.1	17.9	231	229.7	24.1	291	289.4	30.4
52	51.7	5.4	12	111.4	11.7	72	171.1	18.0	32	230.7	24.3	92	290.4	30.5
53	52.7	5.5	13	112.4	11.8	73	172.1	18.1	33	231.7	24.4	93	291.4	30.6
54	53.7	5.6	14	113.4	11.9	74	173.0	18.2	34	232.7	24.5	94	292.4	30.7
55	54.7	5.7	15	114.4	12.0	75	174.0	18.3	35	233.7	24.6	95	293.4	30.8
56	55.7	5.9	16	115.4	12.1	76	175.0	18.4	36	234.7	24.7	96	294.4	30.9
57	56.7	6.0	17	116.4	12.2	77	176.0	18.5	37	235.7	24.8	97	295.4	31.0
58	57.7	6.1	18	117.4	12.3	78	177.0	18.6	38	236.7	24.9	98	296.4	31.1
59	58.7	6.2	19	118.3	12.4	79	178.0	18.7	39	237.7	25.0	99	297.4	31.3
60	59.7	6.3	20	119.3	12.5	80	179.0	18.8	40	238.7	25.1	300	298.4	31.4

Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

[For 84 Degrees.

DIFFERENCE OF LATITUDE AND DEPARTURE FOR 7°.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	1.0	0.1	61	60.5	7.4	121	120.1	14.7	181	179.7	22.1	241	239.2	29.4
2	2.0	0.2	62	61.5	7.6	22	121.1	14.9	82	180.6	22.2	42	240.2	29.5
3	3.0	0.4	63	62.5	7.7	23	122.1	15.0	83	181.6	22.3	43	241.2	29.6
4	4.0	0.5	64	63.5	7.8	24	123.1	15.1	84	182.6	22.4	44	242.2	29.7
5	5.0	0.6	65	64.5	7.9	25	124.1	15.2	85	183.6	22.5	45	243.2	29.9
6	6.0	0.7	66	65.5	8.0	26	125.1	15.4	86	184.6	22.7	46	244.2	30.0
7	6.9	0.9	67	66.5	8.2	27	126.1	15.5	87	185.6	22.8	47	245.2	30.1
8	7.9	1.0	68	67.5	8.3	28	127.0	15.6	88	186.6	22.9	48	246.2	30.2
9	8.9	1.1	69	68.5	8.4	29	128.0	15.7	89	187.6	23.0	49	247.1	30.3
10	9.9	1.2	70	69.5	8.5	30	129.0	15.8	90	188.6	23.2	50	248.1	30.5
11	10.9	1.3	71	70.5	8.7	131	130.0	16.0	191	189.6	23.3	251	249.1	30.6
12	11.9	1.5	72	71.5	8.8	32	131.0	16.1	92	190.6	23.4	52	250.1	30.7
13	12.9	1.6	73	72.5	8.9	33	132.0	16.2	93	191.6	23.5	53	251.1	30.8
14	13.9	1.7	74	73.4	9.0	34	133.0	16.3	94	192.6	23.6	54	252.1	31.0
15	14.9	1.8	75	74.4	9.1	35	134.0	16.5	95	193.5	23.8	55	253.1	31.1
16	15.9	1.9	76	75.4	9.3	36	135.0	16.6	96	194.5	23.9	56	254.1	31.2
17	16.9	2.1	77	76.4	9.4	37	136.0	16.7	97	195.5	24.0	57	255.1	31.3
18	17.9	2.2	78	77.4	9.5	38	137.0	16.8	98	196.5	24.1	58	256.1	31.4
19	18.9	2.3	79	78.4	9.6	39	138.0	16.9	99	197.5	24.3	59	257.1	31.6
20	19.9	2.4	80	79.4	9.7	40	139.0	17.1	200	198.5	24.4	60	258.1	31.7
21	20.8	2.6	81	80.4	9.9	141	139.9	17.2	201	199.5	24.5	261	259.1	31.8
22	21.8	2.7	82	81.4	10.0	42	140.9	17.3	02	200.5	24.6	62	260.0	31.9
23	22.8	2.8	83	82.4	10.1	43	141.9	17.4	03	201.5	24.7	63	261.0	32.1
24	23.8	2.9	84	83.4	10.2	44	142.9	17.5	04	202.5	24.9	64	262.0	32.2
25	24.8	3.0	85	84.4	10.4	45	143.9	17.7	05	203.5	25.0	65	263.0	32.3
26	25.8	3.2	86	85.4	10.5	46	144.9	17.8	06	204.5	25.1	66	264.0	32.4
27	26.8	3.3	87	86.4	10.6	47	145.9	17.9	07	205.5	25.2	67	265.0	32.5
28	27.8	3.4	88	87.3	10.7	48	146.9	18.0	08	206.4	25.3	68	266.0	32.7
29	28.8	3.5	89	88.3	10.8	49	147.9	18.2	09	207.4	25.5	69	267.0	32.8
30	29.8	3.7	90	89.3	11.0	50	148.9	18.3	10	208.4	25.6	70	268.0	32.9
31	30.8	3.8	91	90.3	11.1	151	149.9	18.4	211	209.4	25.7	271	269.0	33.0
32	31.8	3.9	92	91.3	11.2	52	150.9	18.5	12	210.4	25.8	72	270.0	33.1
33	32.8	4.0	93	92.3	11.3	53	151.9	18.6	13	211.4	26.0	73	271.0	33.3
34	33.7	4.1	94	93.3	11.5	54	152.9	18.8	14	212.4	26.1	74	272.0	33.4
35	34.7	4.3	95	94.3	11.6	55	153.8	18.9	15	213.4	26.2	75	273.0	33.5
36	35.7	4.4	96	95.3	11.7	56	154.8	19.0	16	214.4	26.3	76	273.9	33.6
37	36.7	4.5	97	96.3	11.8	57	155.8	19.1	17	215.4	26.4	77	274.9	33.8
38	37.7	4.6	98	97.3	11.9	58	156.8	19.3	18	216.4	26.6	78	275.9	33.9
39	38.7	4.8	99	98.3	12.1	59	157.8	19.4	19	217.4	26.7	79	276.9	34.0
40	39.7	4.9	100	99.3	12.2	60	158.8	19.5	20	218.4	26.8	80	277.9	34.1
41	40.7	5.0	101	100.2	12.3	161	159.8	19.6	221	219.4	26.9	281	278.9	34.2
42	41.7	5.1	02	101.2	12.4	62	160.8	19.7	22	220.3	27.1	82	279.9	34.4
43	42.7	5.2	03	102.2	12.6	63	161.8	19.9	23	221.3	27.2	83	280.9	34.5
44	43.7	5.4	04	103.2	12.7	64	162.8	20.0	24	222.3	27.3	84	281.9	34.6
45	44.7	5.5	05	104.2	12.8	65	163.8	20.1	25	223.3	27.4	85	282.9	34.7
46	45.7	5.6	06	105.2	12.9	66	164.8	20.2	26	224.3	27.5	86	283.9	34.9
47	46.6	5.7	07	106.2	13.0	67	165.8	20.4	27	225.3	27.7	87	284.9	35.0
48	47.6	5.8	08	107.2	13.2	68	166.7	20.5	28	226.3	27.8	88	285.9	35.1
49	48.6	6.0	09	108.2	13.3	69	167.7	20.6	29	227.3	27.9	89	286.8	35.2
50	49.6	6.1	10	109.2	13.4	70	168.7	20.7	30	228.3	28.0	90	287.8	35.3
51	50.6	6.2	111	110.2	13.5	171	169.7	20.8	231	229.3	28.2	291	288.8	35.5
52	51.6	6.3	12	111.2	13.6	72	170.7	21.0	32	230.3	28.3	92	289.8	35.6
53	52.6	6.5	13	112.2	13.8	73	171.7	21.1	33	231.3	28.4	93	290.8	35.7
54	53.6	6.6	14	113.2	13.9	74	172.7	21.2	34	232.3	28.5	94	291.8	35.8
55	54.6	6.7	15	114.1	14.0	75	173.7	21.3	35	233.2	28.6	95	292.8	36.0
56	55.6	6.8	16	115.1	14.1	76	174.7	21.4	36	234.2	28.8	96	293.8	36.1
57	56.6	6.9	17	116.1	14.3	77	175.7	21.6	37	235.2	28.9	97	294.8	36.2
58	57.6	7.1	18	117.1	14.4	78	176.7	21.7	38	236.2	29.0	98	295.8	36.3
59	58.6	7.2	19	118.1	14.5	79	177.7	21.8	39	237.2	29.1	99	296.8	36.4
60	59.6	7.3	20	119.1	14.6	80	178.7	21.9	40	238.2	29.2	300	297.8	36.6

Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

[For 83 Degrees.

DIFFERENCE OF LATITUDE AND DEPARTURE FOR 8°.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	1.0	0.1	61	60.4	8.5	121	119.8	16.8	181	179.2	25.2	241	238.7	33.5
2	2.0	0.3	62	61.4	8.6	22	120.8	17.0	82	180.2	25.3	42	239.6	33.7
3	3.0	0.4	63	62.4	8.8	23	121.8	17.1	83	181.2	25.5	43	240.6	33.8
4	4.0	0.6	64	63.4	8.9	24	122.8	17.3	84	182.2	25.6	44	241.6	34.0
5	5.0	0.7	65	64.4	9.0	25	123.8	17.4	85	183.2	25.7	45	242.6	34.1
6	5.9	0.8	66	65.4	9.2	26	124.8	17.5	86	184.2	25.9	46	243.6	34.2
7	6.9	1.0	67	66.3	9.3	27	125.8	17.7	87	185.2	26.0	47	244.6	34.4
8	7.9	1.1	68	67.3	9.5	28	126.8	17.8	88	186.2	26.2	48	245.6	34.5
9	8.9	1.3	69	68.3	9.6	29	127.7	18.0	89	187.2	26.3	49	246.6	34.7
10	9.9	1.4	70	69.3	9.7	30	128.7	18.1	90	188.2	26.4	50	247.6	34.8
11	10.9	1.5	71	70.3	9.9	131	129.7	18.2	191	189.1	26.6	251	248.6	34.9
12	11.9	1.7	72	71.3	10.0	32	130.7	18.4	92	190.1	26.7	52	249.5	35.1
13	12.9	1.8	73	72.3	10.2	33	131.7	18.5	93	191.1	26.9	53	250.5	35.2
14	13.9	1.9	74	73.3	10.3	34	132.7	18.6	94	192.1	27.0	54	251.5	35.3
15	14.9	2.1	75	74.3	10.4	35	133.7	18.8	95	193.1	27.1	55	252.5	35.5
16	15.8	2.2	76	75.3	10.6	36	134.7	18.9	96	194.1	27.3	56	253.5	35.6
17	16.8	2.4	77	76.3	10.7	37	135.7	19.1	97	195.1	27.4	57	254.5	35.8
18	17.8	2.5	78	77.2	10.9	38	136.7	19.2	98	196.1	27.6	58	255.5	35.9
19	18.8	2.6	79	78.2	11.0	39	137.7	19.3	99	197.1	27.7	59	256.5	36.0
20	19.8	2.8	80	79.2	11.1	40	138.6	19.5	200	198.1	27.8	60	257.5	36.2
21	20.8	2.9	81	80.2	11.3	141	139.6	19.6	201	199.0	28.0	261	258.5	36.3
22	21.8	3.1	82	81.2	11.4	42	140.6	19.8	02	200.0	28.1	62	259.5	36.5
23	22.8	3.2	83	82.2	11.6	43	141.6	19.9	03	201.0	28.3	63	260.4	36.6
24	23.8	3.3	84	83.2	11.7	44	142.6	20.0	04	202.0	28.4	64	261.4	36.7
25	24.8	3.5	85	84.2	11.8	45	143.6	20.2	05	203.0	28.5	65	262.4	36.9
26	25.7	3.6	86	85.2	12.0	46	144.6	20.3	06	204.0	28.7	66	263.4	37.0
27	26.7	3.8	87	86.2	12.1	47	145.6	20.5	07	205.0	28.8	67	264.4	37.2
28	27.7	3.9	88	87.1	12.2	48	146.6	20.6	08	206.0	28.9	68	265.4	37.3
29	28.7	4.0	89	88.1	12.4	49	147.5	20.7	09	207.0	29.1	69	266.4	37.4
30	29.7	4.2	90	89.1	12.5	50	148.5	20.9	10	208.0	29.2	70	267.4	37.6
31	30.7	4.3	91	90.1	12.7	151	149.5	21.0	211	208.9	29.4	271	268.4	37.7
32	31.7	4.5	92	91.1	12.8	52	150.5	21.2	12	209.9	29.5	72	269.4	37.9
33	32.7	4.6	93	92.1	12.9	53	151.5	21.3	13	210.9	29.6	73	270.3	38.0
34	33.7	4.7	94	93.1	13.1	54	152.5	21.4	14	211.9	29.8	74	271.3	38.1
35	34.7	4.9	95	94.1	13.2	55	153.5	21.6	15	212.9	29.9	75	272.3	38.3
36	35.6	5.0	96	95.1	13.4	56	154.5	21.7	16	213.9	30.1	76	273.3	38.4
37	36.6	5.1	97	96.1	13.5	57	155.5	21.9	17	214.9	30.2	77	274.3	38.6
38	37.6	5.3	98	97.0	13.6	58	156.5	22.0	18	215.9	30.3	78	275.3	38.7
39	38.6	5.4	99	98.0	13.8	59	157.5	22.1	19	216.9	30.5	79	276.3	38.8
40	39.6	5.6	100	99.0	13.9	60	158.4	22.3	20	217.9	30.6	80	277.3	39.0
41	40.6	5.7	101	100.0	14.1	161	159.4	22.4	221	218.8	30.8	281	278.3	39.1
42	41.6	5.8	02	101.0	14.2	62	160.4	22.5	22	219.8	30.9	82	279.3	39.2
43	42.6	6.0	03	102.0	14.3	63	161.4	22.7	23	220.8	31.0	83	280.2	39.4
44	43.6	6.1	04	103.0	14.5	64	162.4	22.8	24	221.8	31.2	84	281.2	39.5
45	44.6	6.3	05	104.0	14.6	65	163.4	23.0	25	222.8	31.3	85	282.2	39.7
46	45.6	6.4	06	105.0	14.8	66	164.4	23.1	26	223.8	31.5	86	283.2	39.8
47	46.5	6.5	07	106.0	14.9	67	165.4	23.2	27	224.8	31.6	87	284.2	39.9
48	47.5	6.7	08	106.9	15.0	68	166.4	23.4	28	225.8	31.7	88	285.2	40.1
49	48.5	6.8	09	107.9	15.2	69	167.4	23.5	29	226.8	31.9	89	286.2	40.2
50	49.5	7.0	10	108.9	15.3	70	168.3	23.7	30	227.8	32.0	90	287.2	40.4
51	50.5	7.1	111	109.9	15.4	171	169.3	23.8	231	228.8	32.1	291	288.2	40.5
52	51.5	7.2	12	110.9	15.6	72	170.3	23.9	32	229.7	32.3	92	289.2	40.6
53	52.5	7.4	13	111.9	15.7	73	171.3	24.1	33	230.7	32.4	93	290.1	40.8
54	53.5	7.5	14	112.9	15.9	74	172.3	24.2	34	231.7	32.6	94	291.1	40.9
55	54.5	7.7	15	113.9	16.0	75	173.3	24.4	35	232.7	32.7	95	292.1	41.1
56	55.5	7.8	16	114.9	16.1	76	174.3	24.5	36	233.7	32.8	96	293.1	41.2
57	56.4	7.9	17	115.9	16.3	77	175.3	24.6	37	234.7	33.0	97	294.1	41.3
58	57.4	8.1	18	116.9	16.4	78	176.3	24.8	38	235.7	33.1	98	295.1	41.5
59	58.4	8.2	19	117.8	16.6	79	177.3	24.9	39	236.7	33.3	99	296.1	41.6
60	59.4	8.4	20	118.8	16.7	80	178.2	25.1	40	237.7	33.4	300	297.1	41.8

Dist.	Dep.	Lat.
Dist.	Dep.	Lat.

[For 82 Degrees.

DIFFERENCE OF LATITUDE AND DEPARTURE FOR 9°.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	1.0	0.2	61	60.2	9.5	121	119.5	18.9	181	178.8	28.3	241	238.0	37.7
2	2.0	0.3	62	61.2	9.7	122	120.5	19.1	182	179.8	28.5	42	239.0	37.9
3	3.0	0.5	63	62.2	9.9	123	121.5	19.2	83	180.7	28.6	43	240.0	38.0
4	4.0	0.6	64	63.2	10.0	24	122.5	19.4	84	181.7	28.8	44	241.0	38.2
5	4.9	0.8	65	64.2	10.2	25	123.5	19.6	85	182.7	28.9	45	242.0	38.3
6	5.9	0.9	66	65.2	10.3	26	124.4	19.7	86	183.7	29.1	46	243.0	38.5
7	6.9	1.1	67	66.2	10.5	27	125.4	19.9	87	184.7	29.3	47	244.0	38.6
8	7.9	1.3	68	67.2	10.6	28	126.4	20.0	88	185.7	29.4	48	244.9	38.8
9	8.9	1.4	69	68.2	10.8	29	127.4	20.2	89	186.7	29.6	49	245.9	39.0
10	9.9	1.6	70	69.1	11.0	30	128.4	20.3	90	187.7	29.7	50	246.9	39.1
11	10.9	1.7	71	70.1	11.1	131	129.4	20.5	191	188.6	29.9	251	247.9	39.3
12	11.9	1.9	72	71.1	11.3	32	130.4	20.6	92	189.6	30.0	52	248.9	39.4
13	12.8	2.0	73	72.1	11.4	33	131.4	20.8	93	190.6	30.2	53	249.9	39.6
14	13.8	2.2	74	73.1	11.6	34	132.4	21.0	94	191.6	30.3	54	250.9	39.7
15	14.8	2.3	75	74.1	11.7	35	133.3	21.1	95	192.6	30.5	55	251.9	39.9
16	15.8	2.5	76	75.1	11.9	36	134.3	21.3	96	193.6	30.7	56	252.8	40.0
17	16.8	2.7	77	76.1	12.0	37	135.3	21.4	97	194.6	30.8	57	253.8	40.2
18	17.8	2.8	78	77.0	12.2	38	136.3	21.6	98	195.6	31.0	58	254.8	40.4
19	18.8	3.0	79	78.0	12.4	39	137.3	21.7	99	196.5	31.1	59	255.8	40.5
20	19.8	3.1	80	79.0	12.5	40	138.3	21.9	200	197.5	31.3	60	256.8	40.7
21	20.7	3.3	81	80.0	12.7	141	139.3	22.1	201	198.5	31.4	261	257.8	40.8
22	21.7	3.4	82	81.0	12.8	42	140.3	22.2	02	199.5	31.6	62	258.8	41.0
23	22.7	3.6	83	82.0	13.0	43	141.2	22.4	03	200.5	31.8	63	259.8	41.1
24	23.7	3.8	84	83.0	13.1	44	142.2	22.5	04	201.5	31.9	64	260.7	41.3
25	24.7	3.9	85	84.0	13.3	45	143.2	22.7	05	202.5	32.1	65	261.7	41.5
26	25.7	4.1	86	84.9	13.5	46	144.2	22.8	06	203.5	32.2	66	262.7	41.6
27	26.7	4.2	87	85.9	13.6	47	145.2	23.0	07	204.5	32.4	67	263.7	41.8
28	27.7	4.4	88	86.9	13.8	48	146.2	23.2	08	205.4	32.5	68	264.7	41.9
29	28.6	4.5	89	87.9	13.9	49	147.2	23.3	09	206.4	32.7	69	265.7	42.1
30	29.6	4.7	90	88.9	14.1	50	148.2	23.5	10	207.4	32.9	70	266.7	42.2
31	30.6	4.8	91	89.9	14.2	151	149.1	23.6	211	208.4	33.0	271	267.7	42.4
32	31.6	5.0	92	90.9	14.4	52	150.1	23.8	12	209.4	33.2	72	268.7	42.6
33	32.6	5.2	93	91.9	14.5	53	151.1	23.9	13	210.4	33.3	73	269.6	42.7
34	33.6	5.3	94	92.8	14.7	54	152.1	24.1	14	211.4	33.5	74	270.6	42.9
35	34.6	5.5	95	93.8	14.9	55	153.1	24.2	15	212.4	33.6	75	271.6	43.0
36	35.6	5.6	96	94.8	15.0	56	154.1	24.4	16	213.3	33.8	76	272.6	43.2
37	36.5	5.8	97	95.8	15.2	57	155.1	24.6	17	214.3	33.9	77	273.6	43.3
38	37.5	5.9	98	96.8	15.3	58	156.1	24.7	18	215.3	34.1	78	274.6	43.5
39	38.5	6.1	99	97.8	15.5	59	157.0	24.9	19	216.3	34.3	79	275.6	43.6
40	39.5	6.3	100	98.8	15.6	60	158.0	25.0	20	217.3	34.4	80	276.6	43.8
41	40.5	6.4	101	99.8	15.8	161	159.0	25.2	221	218.3	34.6	281	277.5	44.0
42	41.5	6.6	02	100.7	16.0	62	160.0	25.3	22	219.3	34.7	82	278.5	44.1
43	42.5	6.7	03	101.7	16.1	63	161.0	25.5	23	220.3	34.9	83	279.5	44.3
44	43.5	6.9	04	102.7	16.3	64	162.0	25.7	24	221.2	35.0	84	280.5	44.4
45	44.4	7.0	05	103.7	16.4	65	163.0	25.8	25	222.2	35.2	85	281.5	44.6
46	45.4	7.2	06	104.7	16.6	66	164.0	26.0	26	223.2	35.4	86	282.5	44.7
47	46.4	7.4	07	105.7	16.7	67	164.9	26.1	27	224.2	35.5	87	283.5	44.9
48	47.4	7.5	08	106.7	16.9	68	165.9	26.3	28	225.2	35.7	88	284.5	45.1
49	48.4	7.7	09	107.7	17.1	69	166.9	26.4	29	226.2	35.8	89	285.4	45.2
50	49.4	7.8	10	108.6	17.2	70	167.9	26.6	30	227.2	36.0	90	286.4	45.4
51	50.4	8.0	111	109.6	17.4	171	168.9	26.8	231	228.2	36.1	291	287.4	45.5
52	51.4	8.1	12	110.6	17.5	72	169.9	26.9	32	229.1	36.3	92	288.4	45.7
53	52.3	8.3	13	111.6	17.7	73	170.9	27.1	33	230.1	36.4	93	289.4	45.8
54	53.3	8.4	14	112.6	17.8	74	171.9	27.2	34	231.1	36.6	94	290.4	46.0
55	54.3	8.6	15	113.6	18.0	75	172.8	27.4	35	232.1	36.8	95	291.4	46.1
56	55.3	8.8	16	114.6	18.1	76	173.8	27.5	36	233.1	36.9	96	292.4	46.3
57	56.3	8.9	17	115.6	18.3	77	174.8	27.7	37	234.1	37.1	97	293.3	46.4
58	57.3	9.1	18	116.5	18.5	78	175.8	27.8	38	235.1	37.2	98	294.3	46.6
59	58.3	9.2	19	117.5	18.6	79	176.8	28.0	39	236.1	37.4	99	295.3	46.8
60	59.3	9.4	20	118.5	18.8	80	177.8	28.2	40	237.0	37.5	300	296.3	46.9

Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

[For 81 Degrees.

DIFFERENCE OF LATITUDE AND DEPARTURE FOR 10°.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	1.0	0.2	61	60.1	10.6	121	119.2	21.0	181	178.3	31.4	241	237.3	41.8
2	2.0	0.3	62	61.1	10.8	22	120.1	21.2	82	179.2	31.6	42	238.3	42.0
3	3.0	0.5	63	62.0	10.9	23	121.1	21.4	83	180.2	31.8	43	239.3	42.2
4	3.9	0.7	64	63.0	11.1	24	122.1	21.5	84	181.2	32.0	44	240.3	42.4
5	4.9	0.9	65	64.0	11.3	25	123.1	21.7	85	182.2	32.1	45	241.3	42.5
6	5.9	1.0	66	65.0	11.5	26	124.1	21.9	86	183.2	32.3	46	242.3	42.7
7	6.9	1.2	67	66.0	11.6	27	125.1	22.1	87	184.2	32.5	47	243.2	42.9
8	7.9	1.4	68	67.0	11.8	28	126.1	22.2	88	185.1	32.6	48	244.2	43.1
9	8.9	1.6	69	68.0	12.0	29	127.1	22.4	89	186.1	32.8	49	245.2	43.2
10	9.8	1.7	70	68.9	12.2	30	128.0	22.6	90	187.1	33.0	50	246.2	43.4
11	10.8	1.9	71	69.9	12.3	131	129.0	22.7	191	188.1	33.2	251	247.2	43.6
12	11.8	2.1	72	70.9	12.5	32	130.0	22.9	92	189.1	33.3	52	248.2	43.8
13	12.8	2.3	73	71.9	12.7	33	131.0	23.1	93	190.1	33.5	53	249.2	43.9
14	13.8	2.4	74	72.9	12.8	34	132.0	23.3	94	191.1	33.7	54	250.1	44.1
15	14.8	2.6	75	73.9	13.0	35	132.9	23.4	95	192.0	33.9	55	251.1	44.3
16	15.8	2.8	76	74.8	13.2	36	133.9	23.6	96	193.0	34.0	56	252.1	44.5
17	16.7	3.0	77	75.8	13.4	37	134.9	23.8	97	194.0	34.2	57	253.1	44.6
18	17.7	3.1	78	76.8	13.5	38	135.9	24.0	98	195.0	34.4	58	254.1	44.8
19	18.7	3.3	79	77.8	13.7	39	136.9	24.1	99	196.0	34.6	59	255.1	45.0
20	19.7	3.5	80	78.8	13.9	40	137.9	24.3	200	197.0	34.7	60	256.1	45.1
21	20.7	3.6	81	79.8	14.1	141	138.9	24.5	201	197.9	34.9	261	257.0	45.3
22	21.7	3.8	82	80.8	14.2	42	139.8	24.7	02	198.9	35.1	62	258.0	45.5
23	22.7	4.0	83	81.7	14.4	43	140.8	24.8	03	199.9	35.3	63	259.0	45.7
24	23.6	4.2	84	82.7	14.6	44	141.8	25.0	04	200.9	35.4	64	260.0	45.8
25	24.6	4.3	85	83.7	14.8	45	142.8	25.2	05	201.9	35.6	65	261.0	46.0
26	25.6	4.5	86	84.7	14.9	46	143.8	25.4	06	202.9	35.8	66	262.0	46.2
27	26.6	4.7	87	85.7	15.1	47	144.8	25.4	07	203.9	35.9	67	262.9	46.4
28	27.6	4.9	88	86.7	15.3	48	145.8	25.7	08	204.8	36.1	68	263.9	46.5
29	28.6	5.0	89	87.6	15.5	49	146.7	25.9	09	205.8	36.3	69	264.9	46.7
30	29.5	5.2	90	88.6	15.6	50	147.7	26.0	10	206.8	36.5	70	265.9	46.9
31	30.5	5.4	91	89.6	15.8	151	148.7	26.2	211	207.8	36.6	271	266.9	47.1
32	31.5	5.6	92	90.6	16.0	52	149.7	26.4	12	208.8	36.8	72	267.9	47.2
33	32.5	5.7	93	91.6	16.1	53	150.7	26.6	13	209.8	37.0	73	268.9	47.4
34	33.5	5.9	94	92.6	16.3	54	151.7	26.7	14	210.7	37.2	74	269.8	47.6
35	34.5	6.1	95	93.6	16.5	55	152.6	26.9	15	211.7	37.3	75	270.8	47.8
36	35.5	6.3	96	94.5	16.7	56	153.6	27.1	16	212.7	37.5	76	271.8	47.9
37	36.4	6.4	97	95.5	16.8	57	154.6	27.3	17	213.7	37.7	77	272.8	48.1
38	37.4	6.6	98	96.5	17.0	58	155.6	27.4	18	214.7	37.9	78	273.8	48.3
39	38.4	6.8	99	97.5	17.2	59	156.6	27.6	19	215.7	38.0	79	274.8	48.4
40	39.4	6.9	100	98.5	17.4	60	157.6	27.8	20	216.7	38.2	80	275.7	48.6
41	40.4	7.1	101	99.5	17.5	161	158.6	28.0	221	217.6	38.4	281	276.7	48.8
42	41.4	7.3	02	100.5	17.7	62	159.5	28.1	22	218.6	38.5	82	277.7	49.0
43	42.3	7.5	03	101.4	17.9	63	160.5	28.3	23	219.6	38.7	83	278.7	49.1
44	43.3	7.6	04	102.4	18.1	64	161.5	28.5	24	220.6	38.9	84	279.7	49.3
45	44.3	7.8	05	103.4	18.2	65	162.5	28.7	25	221.6	39.1	85	280.7	49.5
46	45.3	8.0	06	104.4	18.4	66	163.5	28.8	26	222.6	39.2	86	281.7	49.7
47	46.3	8.2	07	105.4	18.6	67	164.5	29.0	27	223.6	39.4	87	282.6	49.8
48	47.3	8.3	08	106.4	18.8	68	165.4	29.2	28	224.5	39.6	88	283.6	50.0
49	48.3	8.5	09	107.3	18.9	69	166.4	29.3	29	225.5	39.8	89	284.6	50.2
50	49.2	8.7	10	108.3	19.1	70	167.4	29.5	30	226.5	39.9	90	285.6	50.4
51	50.2	8.9	111	109.3	19.3	171	168.4	29.7	231	227.5	40.1	291	286.6	50.5
52	51.2	9.0	12	110.3	19.4	72	169.4	29.9	32	228.5	40.3	92	287.6	50.7
53	52.2	9.2	13	111.3	19.6	73	170.4	30.0	33	229.5	40.5	93	288.5	50.9
54	53.2	9.4	14	112.3	19.8	74	171.4	30.2	34	230.4	40.6	94	289.5	51.1
55	54.2	9.6	15	113.3	20.0	75	172.3	30.4	35	231.4	40.8	95	290.5	51.2
56	55.1	9.7	16	114.2	20.1	76	173.3	30.6	36	232.4	41.0	96	291.5	51.4
57	56.1	9.9	17	115.2	20.3	77	174.3	30.7	37	233.4	41.2	97	292.5	51.6
58	57.1	10.1	18	116.2	20.5	78	175.3	30.9	38	234.4	41.3	98	293.5	51.7
59	58.1	10.2	19	117.2	20.7	79	176.3	31.1	39	235.4	41.5	99	294.5	51.9
60	59.1	10.4	20	118.2	20.8	80	177.3	31.3	40	236.4	41.7	300	295.4	52.1

Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

[For 80 Degrees.

DIFFERENCE OF LATITUDE AND DEPARTURE FOR 11°.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	1.0	0.2	61	59.9	11.6	121	118.8	23.1	181	177.7	34.5	241	236.6	46.0
2	2.0	0.4	62	60.9	11.8	22	119.8	23.3	82	178.7	34.7	42	237.6	46.2
3	2.9	0.6	63	61.8	12.0	23	120.7	23.5	83	179.6	34.9	43	238.5	46.4
4	3.9	0.8	64	62.8	12.2	24	121.7	23.7	84	180.6	35.1	44	239.5	46.6
5	4.9	1.0	65	63.8	12.4	25	122.7	23.9	85	181.6	35.3	45	240.5	46.7
6	5.9	1.1	66	64.8	12.6	26	123.7	24.0	86	182.6	35.5	46	241.5	46.9
7	6.9	1.3	67	65.8	12.8	27	124.7	24.2	87	183.6	35.7	47	242.5	47.1
8	7.9	1.5	68	66.8	13.0	28	125.6	24.4	88	184.5	35.9	48	243.4	47.3
9	8.8	1.7	69	67.7	13.2	29	126.6	24.6	89	185.5	36.1	49	244.4	47.5
10	9.8	1.9	70	68.7	13.4	30	127.6	24.8	90	186.5	36.3	50	245.4	47.7
11	10.8	2.1	71	69.7	13.5	131	128.6	25.0	191	187.5	36.4	251	246.4	47.9
12	11.8	2.3	72	70.7	13.7	32	129.6	25.2	92	188.5	36.6	52	247.4	48.1
13	12.8	2.5	73	71.7	13.9	33	130.6	25.4	93	189.5	36.8	53	248.4	48.3
14	13.7	2.7	74	72.6	14.1	34	131.5	25.6	94	190.4	37.0	54	249.3	48.5
15	14.7	2.9	75	73.6	14.3	35	132.5	25.8	95	191.4	37.2	55	250.3	48.7
16	15.7	3.1	76	74.6	14.5	36	133.5	26.0	96	192.4	37.4	56	251.3	48.8
17	16.7	3.2	77	75.6	14.7	37	134.5	26.1	97	193.4	37.6	57	252.3	49.0
18	17.7	3.4	78	76.6	14.9	38	135.5	26.3	98	194.4	37.8	58	253.3	49.2
19	18.7	3.6	79	77.5	15.1	39	136.4	26.5	99	195.3	38.0	59	254.2	49.4
20	19.6	3.8	80	78.5	15.3	40	137.4	26.7	200	196.3	38.2	60	255.2	49.6
21	20.6	4.0	81	79.5	15.5	141	138.4	26.9	201	197.3	38.4	261	256.2	49.8
22	21.6	4.2	82	80.5	15.6	42	139.4	27.1	02	198.3	38.5	62	257.2	50.0
23	22.6	4.4	83	81.5	15.8	43	140.4	27.3	03	199.3	38.7	63	258.2	50.2
24	23.6	4.6	84	82.5	16.0	44	141.4	27.5	04	200.3	38.9	64	259.1	50.4
25	24.5	4.8	85	83.4	16.2	45	142.3	27.7	05	201.2	39.1	65	260.1	50.6
26	25.5	5.0	86	84.4	16.4	46	143.3	27.9	06	202.2	39.3	66	261.1	50.8
27	26.5	5.2	87	85.4	16.6	47	144.3	28.0	07	203.2	39.5	67	262.1	50.9
28	27.5	5.3	88	86.4	16.8	48	145.3	28.2	08	204.2	39.7	68	263.1	51.1
29	28.5	5.5	89	87.4	17.0	49	146.3	28.4	09	205.2	39.9	69	264.1	51.3
30	29.4	5.7	90	88.3	17.2	50	147.2	28.6	10	206.1	40.1	70	265.0	51.5
31	30.4	5.9	91	89.3	17.4	151	148.2	28.8	211	207.1	40.3	271	266.0	51.7
32	31.4	6.1	92	90.3	17.6	52	149.2	29.0	12	208.1	40.5	72	267.0	51.9
33	32.4	6.3	93	91.3	17.7	53	150.2	29.2	13	209.1	40.6	73	268.0	52.1
34	33.4	6.5	94	92.3	17.9	54	151.2	29.4	14	210.1	40.8	74	269.0	52.3
35	34.4	6.7	95	93.3	18.1	55	152.2	29.6	15	211.0	41.0	75	269.9	52.5
36	35.3	6.9	96	94.2	18.3	56	153.1	29.8	16	212.0	41.2	76	270.9	52.7
37	36.3	7.1	97	95.2	18.5	57	154.1	30.0	17	213.0	41.4	77	271.9	52.9
38	37.3	7.3	98	96.2	18.7	58	155.1	30.1	18	214.0	41.6	78	272.9	53.0
39	38.3	7.4	99	97.2	18.9	59	156.1	30.3	19	215.0	41.8	79	273.9	53.2
40	39.3	7.6	100	98.2	19.1	60	157.1	30.5	20	216.0	42.0	80	274.9	53.4
41	40.2	7.8	101	99.1	19.3	101	158.0	30.7	221	216.9	42.2	281	275.8	53.6
42	41.2	8.0	02	100.1	19.5	62	159.0	30.9	22	217.9	42.4	82	276.8	53.8
43	42.2	8.2	03	101.1	19.7	63	160.0	31.1	23	218.9	42.6	83	277.8	54.0
44	43.2	8.4	04	102.1	19.8	64	161.0	31.3	24	219.9	42.7	84	278.8	54.2
45	44.2	8.6	05	103.1	20.0	65	162.0	31.5	25	220.9	42.9	85	279.8	54.4
46	45.2	8.8	06	104.1	20.2	66	163.0	31.7	26	221.8	43.1	86	280.7	54.6
47	46.1	9.0	07	105.0	20.4	67	163.9	31.9	27	222.8	43.3	87	281.7	54.8
48	47.1	9.2	08	106.0	20.6	68	164.9	32.1	28	223.8	43.5	88	282.7	55.0
49	48.1	9.3	09	107.0	20.8	69	165.9	32.2	29	224.8	43.7	89	283.7	55.1
50	49.1	9.5	10	108.0	21.0	70	166.9	32.4	30	225.8	43.9	90	284.7	55.3
51	50.1	9.7	111	109.0	21.2	171	167.9	32.6	231	226.8	44.1	291	285.7	55.5
52	51.0	9.9	12	109.9	21.4	72	168.8	32.8	32	227.7	44.3	92	286.6	55.7
53	52.0	10.1	13	110.9	21.6	73	169.8	33.0	33	228.7	44.5	93	287.6	55.9
54	53.0	10.3	14	111.9	21.8	74	170.8	33.2	34	229.7	44.6	94	288.6	56.1
55	54.0	10.5	15	112.9	21.9	75	171.8	33.4	35	230.7	44.8	95	289.6	56.3
56	55.0	10.7	16	113.9	22.1	76	172.8	33.6	36	231.7	45.0	96	290.6	56.5
57	56.0	10.9	17	114.9	22.3	77	173.7	33.8	37	232.6	45.2	97	291.5	56.7
58	56.9	11.1	18	115.8	22.5	78	174.7	34.0	38	233.6	45.4	98	292.5	56.9
59	57.9	11.3	19	116.8	22.7	79	175.7	34.2	39	234.6	45.6	99	293.5	57.1
60	58.9	11.4	20	117.8	22.9	80	176.7	34.3	40	235.6	45.8	300	294.5	57.2

Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

[For 79 Degrees.

DIFFERENCE OF LATITUDE AND DEPARTURE FOR 12°.

Dist.	Lat.	Dep	Dist.	Lat.	Dep	Dist	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	1.0	0.2	61	59.7	12.7	121	118.4	25.2	181	177.0	37.6	241	235.7	50.1
2	2.0	0.4	62	60.6	12.9	22	119.3	25.4	82	178.0	37.8	42	236.7	50.3
3	2.9	0.6	63	61.6	13.1	23	120.3	25.6	83	179.0	38.0	43	237.7	50.5
4	3.9	0.8	64	62.6	13.3	24	121.3	25.8	84	180.0	38.3	44	238.7	50.7
5	4.9	1.0	65	63.6	13.5	25	122.3	26.0	85	181.0	38.5	45	239.6	50.9
6	5.9	1.2	66	64.6	13.7	26	123.2	26.2	86	181.9	38.7	46	240.6	51.1
7	6.8	1.5	67	65.5	13.9	27	124.2	26.4	87	182.9	38.9	47	241.6	51.4
8	7.8	1.7	68	66.5	14.1	28	125.2	26.6	88	183.9	39.1	48	242.6	51.6
9	8.8	1.9	69	67.5	14.3	29	126.2	26.8	89	184.9	39.3	49	243.6	51.8
10	9.8	2.1	70	68.5	14.6	30	127.2	27.0	90	185.8	39.5	50	244.5	52.0
11	10.8	2.3	71	69.4	14.8	131	128.1	27.2	191	186.8	39.7	251	245.5	52.2
12	11.7	2.5	72	70.4	15.0	32	129.1	27.4	92	187.8	39.9	52	246.5	52.4
13	12.7	2.7	73	71.4	15.2	33	130.1	27.7	93	188.8	40.1	53	247.5	52.6
14	13.7	2.9	74	72.4	15.4	34	131.1	27.9	94	189.8	40.3	54	248.4	52.8
15	14.7	3.1	75	73.4	15.6	35	132.0	28.1	95	190.7	40.5	55	249.4	53.0
16	15.7	3.3	76	74.3	15.8	36	133.0	28.3	96	191.7	40.8	56	250.4	53.2
17	16.6	3.5	77	75.3	16.0	37	134.0	28.5	97	192.7	41.0	57	251.4	53.4
18	17.6	3.7	78	76.3	16.2	38	135.0	28.7	98	193.7	41.2	58	252.4	53.6
19	18.6	4.0	79	77.3	16.4	39	136.0	28.9	99	194.7	41.4	59	253.3	53.8
20	19.6	4.2	80	78.3	16.6	40	136.9	29.1	200	195.6	41.6	60	254.3	54.1
21	20.5	4.4	81	79.2	16.8	141	137.9	29.3	201	196.6	41.8	261	255.3	54.3
22	21.5	4.6	82	80.2	17.0	42	138.9	29.5	02	197.6	42.0	62	256.3	54.5
23	22.5	4.8	83	81.2	17.3	43	139.9	29.7	03	198.6	42.2	63	257.3	54.7
24	23.5	5.0	84	82.2	17.5	44	140.9	29.9	04	199.5	42.4	64	258.2	54.9
25	24.5	5.2	85	83.1	17.7	45	141.8	30.1	05	200.5	42.6	65	259.2	55.1
26	25.4	5.4	86	84.1	17.9	46	142.8	30.4	06	201.5	42.8	66	260.2	55.3
27	26.4	5.6	87	85.1	18.1	47	143.8	30.6	07	202.5	43.0	67	261.2	55.5
28	27.4	5.8	88	86.1	18.3	48	144.8	30.8	08	203.5	43.2	68	262.1	55.7
29	28.4	6.0	89	87.1	18.5	49	145.7	31.0	09	204.4	43.5	69	263.1	55.9
30	29.3	6.2	90	88.0	18.7	50	146.7	31.2	10	205.4	43.7	70	264.1	56.1
31	30.3	6.4	91	89.0	18.9	151	147.7	31.4	211	206.4	43.9	271	265.1	56.3
32	31.3	6.7	92	90.0	19.1	52	148.7	31.6	12	207.4	44.1	72	266.1	56.6
33	32.3	6.9	93	91.0	19.3	53	149.7	31.8	13	208.3	44.3	73	267.0	56.8
34	33.3	7.1	94	91.9	19.5	54	150.6	32.0	14	209.3	44.5	74	268.0	57.0
35	34.2	7.3	95	92.9	19.8	55	151.6	32.2	15	210.3	44.7	75	269.0	57.2
36	35.2	7.5	96	93.9	20.0	56	152.6	32.4	16	211.3	44.9	76	270.0	57.4
37	36.2	7.7	97	94.9	20.2	57	153.6	32.6	17	212.3	45.1	77	270.9	57.6
38	37.2	7.9	98	95.9	20.4	58	154.5	32.9	18	213.2	45.3	78	271.9	57.8
39	38.1	8.1	99	96.8	20.6	59	155.5	33.1	19	214.2	45.5	79	272.9	58.0
40	39.1	8.3	100	97.8	20.8	60	156.5	33.3	20	215.2	45.7	80	273.9	58.2
41	40.1	8.5	101	98.8	21.0	161	157.5	33.5	221	216.2	45.9	281	274.9	58.4
42	41.1	8.7	02	99.8	21.2	62	158.5	33.7	22	217.1	46.2	82	275.8	58.6
43	42.1	8.9	03	100.7	21.4	63	159.4	33.9	23	218.1	46.4	83	276.8	58.8
44	43.0	9.1	04	101.7	21.6	64	160.4	34.1	24	219.1	46.6	84	277.8	59.0
45	44.0	9.4	05	102.7	21.8	65	161.4	34.3	25	220.1	46.8	85	278.8	59.3
46	45.0	9.6	06	103.7	22.0	66	162.4	34.5	26	221.1	47.0	86	279.8	59.5
47	46.0	9.8	07	104.7	22.2	67	163.4	34.7	27	222.0	47.2	87	280.7	59.7
48	47.0	10.0	08	105.7	22.5	68	164.3	34.9	28	223.0	47.4	88	281.7	59.9
49	47.9	10.2	09	106.6	22.7	69	165.3	35.1	29	224.0	47.6	89	282.7	60.1
50	48.9	10.4	10	107.6	22.9	70	166.3	35.3	30	225.0	47.8	90	283.7	60.3
51	49.9	10.6	111	108.6	23.1	171	167.3	35.6	231	226.0	48.0	291	284.6	60.5
52	50.9	10.8	12	109.6	23.3	72	168.2	35.8	32	226.9	48.2	92	285.6	60.7
53	51.8	11.0	13	110.5	23.5	73	169.2	36.0	33	227.9	48.4	93	286.6	60.9
54	52.8	11.2	14	111.5	23.7	74	170.2	36.2	34	228.9	48.7	94	287.6	61.1
55	53.8	11.4	15	112.5	23.9	75	171.2	36.4	35	229.9	48.9	95	288.6	61.3
56	54.8	11.6	16	113.5	24.1	76	172.2	36.6	36	230.8	49.1	96	289.5	61.5
57	55.8	11.9	17	114.4	24.3	77	173.1	36.8	37	231.8	49.3	97	290.5	61.7
58	56.7	12.1	18	115.4	24.5	78	174.1	37.0	38	232.8	49.5	98	291.5	62.0
59	57.7	12.3	19	116.4	24.7	79	175.1	37.2	39	233.8	49.7	99	292.5	62.2
60	58.7	12.5	20	117.4	24.9	80	176.1	37.4	40	234.8	49.9	300	293.4	62.4

Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep	Lat.	Dist.	Dep.	Lat.	Dist.	Dep	Lat.

[For 78 Degrees.

DIFFERENCE OF LATITUDE AND DEPARTURE FOR 13°.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	1.0	0.2	61	59.4	13.7	121	117.9	27.2	181	176.4	40.7	241	234.8	54.2
2	1.9	0.4	62	60.4	13.9	22	118.9	27.4	82	177.3	40.9	42	235.8	54.4
3	2.9	0.7	63	61.4	14.2	23	119.8	27.7	83	178.3	41.2	43	236.8	54.7
4	3.9	0.9	64	62.4	14.4	24	120.8	27.9	84	179.3	41.4	44	237.7	54.9
5	4.9	1.1	65	63.3	14.6	25	121.8	28.1	85	180.3	41.6	45	238.7	55.1
6	5.8	1.3	66	64.3	14.8	26	122.8	28.3	86	181.2	41.8	46	239.7	55.3
7	6.8	1.6	67	65.3	15.1	27	123.7	28.6	87	182.2	42.1	47	240.7	55.6
8	7.8	1.8	68	66.3	15.3	28	124.7	28.8	88	183.2	42.3	48	241.6	55.8
9	8.8	2.0	69	67.2	15.5	29	125.7	29.0	89	184.2	42.5	49	242.6	56.0
10	9.7	2.2	70	68.2	15.7	30	126.7	29.2	90	185.1	42.7	50	243.6	56.2
11	10.7	2.5	71	69.2	16.0	131	127.6	29.5	191	186.1	43.0	251	244.6	56.5
12	11.7	2.7	72	70.2	16.2	32	128.6	29.7	92	187.1	43.2	52	245.5	56.7
13	12.7	2.9	73	71.1	16.4	33	129.6	29.9	93	188.1	43.4	53	246.5	56.9
14	13.6	3.1	74	72.1	16.6	34	130.6	30.1	94	189.0	43.6	54	247.5	57.1
15	14.6	3.4	75	73.1	16.9	35	131.5	30.4	95	190.0	43.9	55	248.5	57.4
16	15.6	3.6	76	74.1	17.1	36	132.5	30.6	96	191.0	44.1	56	249.4	57.6
17	16.6	3.8	77	75.0	17.3	37	133.5	30.8	97	192.0	44.3	57	250.4	57.8
18	17.5	4.0	78	76.0	17.5	38	134.5	31.0	98	192.9	44.5	58	251.4	58.0
19	18.5	4.3	79	77.0	17.8	39	135.4	31.3	99	193.9	44.8	59	252.4	58.3
20	19.5	4.5	80	77.9	18.0	40	136.4	31.5	200	194.9	45.0	60	253.3	58.5
21	20.5	4.7	81	78.9	18.2	141	137.4	31.7	201	195.8	45.2	261	254.3	58.7
22	21.4	4.9	82	79.9	18.4	42	138.4	31.9	02	196.8	45.4	62	255.3	58.9
23	22.4	5.2	83	80.9	18.7	43	139.3	32.2	03	197.8	45.7	63	256.3	59.2
24	23.4	5.4	84	81.8	18.9	44	140.3	32.4	04	198.8	45.9	64	257.2	59.4
25	24.4	5.6	85	82.8	19.1	45	141.3	32.6	05	199.7	46.1	65	258.2	59.6
26	25.3	5.8	86	83.8	19.3	46	142.3	32.8	06	200.7	46.3	66	259.2	59.8
27	26.3	6.1	87	84.8	19.6	47	143.2	33.1	07	201.7	46.6	67	260.2	60.1
28	27.3	6.3	88	85.7	19.8	48	144.2	33.3	08	202.7	46.8	68	261.1	60.3
29	28.3	6.5	89	86.7	20.0	49	145.2	33.5	09	203.6	47.0	69	262.1	60.5
30	29.2	6.7	90	87.7	20.2	50	146.2	33.7	10	204.6	47.2	70	263.1	60.7
31	30.2	7.0	91	88.7	20.5	151	147.1	34.0	211	205.6	47.5	271	264.1	61.0
32	31.2	7.2	92	89.6	20.7	52	148.1	34.2	12	206.6	47.7	72	265.0	61.2
33	32.2	7.4	93	90.6	20.9	53	149.1	34.4	13	207.5	47.9	73	266.0	61.4
34	33.1	7.6	94	91.6	21.1	54	150.1	34.6	14	208.5	48.1	74	267.0	61.6
35	34.1	7.9	95	92.6	21.4	55	151.0	34.9	15	209.5	48.4	75	268.0	61.9
36	35.1	8.1	96	93.5	21.6	56	152.0	35.1	16	210.5	48.6	76	268.9	62.1
37	36.1	8.3	97	94.5	21.8	57	153.0	35.3	17	211.4	48.8	77	269.9	62.3
38	37.0	8.5	98	95.5	22.0	58	154.0	35.5	18	212.4	49.0	78	270.9	62.5
39	38.0	8.8	99	96.5	22.3	59	154.9	35.8	19	213.4	49.3	79	271.8	62.8
40	39.0	9.0	100	97.4	22.5	60	155.9	36.0	20	214.4	49.5	80	272.8	63.0
41	39.9	9.2	101	98.4	22.7	161	156.9	36.2	221	215.3	49.7	281	273.8	63.2
42	40.9	9.4	02	99.4	22.9	62	157.8	36.4	22	216.3	49.9	82	274.8	63.4
43	41.9	9.7	03	100.4	23.2	63	158.8	36.7	23	217.3	50.2	83	275.7	63.7
44	42.9	9.9	04	101.3	23.4	64	159.8	36.9	24	218.3	50.4	84	276.7	63.9
45	43.8	10.1	05	102.3	23.6	65	160.8	37.1	25	219.2	50.6	85	277.7	64.1
46	44.8	10.3	06	103.3	23.8	66	161.7	37.3	26	220.2	50.8	86	278.7	64.3
47	45.8	10.6	07	104.3	24.1	67	162.7	37.6	27	221.2	51.1	87	279.6	64.6
48	46.8	10.8	08	105.2	24.3	68	163.7	37.8	28	222.2	51.3	88	280.6	64.8
49	47.7	11.0	09	106.2	24.5	69	164.7	38.0	29	223.1	51.5	89	281.6	65.0
50	48.7	11.2	10	107.2	24.7	70	165.6	38.2	30	224.1	51.7	90	282.6	65.2
51	49.7	11.5	111	108.2	25.0	171	166.6	38.5	231	225.1	52.0	291	283.5	65.5
52	50.7	11.7	12	109.1	25.2	72	167.6	38.7	32	226.1	52.2	92	284.5	65.7
53	51.6	11.9	13	110.1	25.4	73	168.6	38.9	33	227.0	52.4	93	285.5	65.9
54	52.6	12.1	14	111.1	25.6	74	169.5	39.1	34	228.0	52.6	94	286.5	66.1
55	53.6	12.4	15	112.1	25.9	75	170.5	39.4	35	229.0	52.9	95	287.4	66.4
56	54.6	12.6	16	113.0	26.1	76	171.5	39.6	36	230.0	53.1	96	288.4	66.6
57	55.5	12.8	17	114.0	26.3	77	172.5	39.8	37	230.9	53.3	97	289.4	66.8
58	56.5	13.0	18	115.0	26.5	78	173.4	40.0	38	231.9	53.5	98	290.4	67.0
59	57.5	13.3	19	116.0	26.8	79	174.4	40.3	39	232.9	53.8	99	291.3	67.3
60	58.5	13.5	20	116.9	27.0	80	175.4	40.5	40	233.8	54.0	300	292.3	67.5

Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

[For 77 Degrees.

DIFFERENCE OF LATITUDE AND DEPARTURE FOR 14°.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	1.0	0.2	61	59.2	14.8	121	117.4	29.3	181	175.6	43.8	241	233.8	58.3
2	1.9	0.5	62	60.2	15.0	22	118.4	29.5	82	176.6	44.0	42	234.8	58.5
3	2.9	0.7	63	61.1	15.2	23	119.3	29.8	83	177.6	44.3	43	235.8	58.8
4	3.9	1.0	64	62.1	15.5	24	120.3	30.0	84	178.5	44.5	44	236.8	59.0
5	4.9	1.2	65	63.1	15.7	25	121.3	30.2	85	179.5	44.8	45	237.7	59.3
6	5.8	1.5	66	64.0	16.0	26	122.3	30.5	86	180.5	45.0	46	238.7	59.5
7	6.8	1.7	67	65.0	16.2	27	123.2	30.7	87	181.4	45.2	47	239.7	59.8
8	7.8	1.9	68	66.0	16.5	28	124.2	31.0	88	182.4	45.5	48	240.6	60.0
9	8.7	2.2	69	67.0	16.7	29	125.2	31.2	89	183.4	45.7	49	241.6	60.2
10	9.7	2.4	70	67.9	16.9	30	126.1	31.4	90	184.4	46.0	50	242.6	60.5
11	10.7	2.7	71	68.9	17.2	131	127.1	31.7	191	185.3	46.2	251	243.5	60.7
12	11.6	2.9	72	69.9	17.4	32	128.1	31.9	92	186.3	46.4	52	244.5	61.0
13	12.6	3.1	73	70.8	17.7	33	129.0	32.2	93	187.3	46.7	53	245.5	61.2
14	13.6	3.4	74	71.8	17.9	34	130.0	32.4	94	188.2	46.9	54	246.5	61.4
15	14.6	3.6	75	72.8	18.1	35	131.0	32.7	95	189.2	47.2	55	247.4	61.7
16	15.5	3.9	76	73.7	18.4	36	132.0	32.9	96	190.2	47.4	56	248.4	61.9
17	16.5	4.1	77	74.7	18.6	37	132.9	33.1	97	191.1	47.7	57	249.4	62.2
18	17.5	4.4	78	75.7	18.9	38	133.9	33.4	98	192.1	47.9	58	250.3	62.4
19	18.4	4.6	79	76.7	19.1	39	134.9	33.6	99	193.1	48.1	59	251.3	62.7
20	19.4	4.8	80	77.6	19.4	40	135.8	33.9	200	194.1	48.4	60	252.3	62.9
21	20.4	5.1	81	78.6	19.6	141	136.8	34.1	201	195.0	48.6	261	253.2	63.1
22	21.3	5.3	82	79.6	19.8	42	137.8	34.4	02	196.0	48.9	62	254.2	63.4
23	22.3	5.6	83	80.5	20.1	43	138.8	34.6	03	197.0	49.1	63	255.2	63.6
24	23.3	5.8	84	81.5	20.3	44	139.7	34.8	04	197.9	49.4	64	256.2	63.9
25	24.3	6.0	85	82.5	20.6	45	140.7	35.1	05	198.9	49.6	65	257.1	64.1
26	25.2	6.3	86	83.4	20.8	46	141.7	35.3	06	199.9	49.8	66	258.1	64.4
27	26.2	6.5	87	84.4	21.0	47	142.6	35.6	07	200.9	50.1	67	259.1	64.6
28	27.2	6.8	88	85.4	21.3	48	143.6	35.8	08	201.8	50.3	68	260.0	64.8
29	28.1	7.0	89	86.4	21.5	49	144.6	36.0	09	202.8	50.6	69	261.0	65.1
30	29.1	7.3	90	87.3	21.8	50	145.5	36.3	10	203.8	50.8	270	262.0	65.3
31	30.1	7.5	91	88.3	22.0	151	146.5	36.5	211	204.7	51.0	271	263.0	65.6
32	31.0	7.7	92	89.3	22.3	52	147.5	36.8	12	205.7	51.3	72	263.9	65.8
33	32.0	8.0	93	90.2	22.5	53	148.5	37.0	13	206.7	51.5	73	264.9	66.0
34	33.0	8.2	94	91.2	22.7	54	149.4	37.3	14	207.6	51.8	74	265.9	66.3
35	34.0	8.5	95	92.2	23.0	55	150.4	37.5	15	208.6	52.0	75	266.8	66.5
36	34.9	8.7	96	93.1	23.2	56	151.4	37.7	16	209.6	52.3	76	267.8	66.8
37	35.9	9.0	97	94.1	23.5	57	152.3	38.0	17	210.6	52.5	77	268.8	67.0
38	36.9	9.2	98	95.1	23.7	58	153.3	38.2	18	211.5	52.7	78	269.7	67.3
39	37.8	9.4	99	96.1	24.0	59	154.3	38.5	19	212.5	53.0	79	270.7	67.5
40	38.8	9.7	100	97.0	24.2	60	155.2	38.7	20	213.5	53.2	80	271.7	67.7
41	39.8	9.9	101	98.0	24.4	161	156.2	38.9	221	214.4	53.5	281	272.7	68.0
42	40.8	10.2	02	99.0	24.7	62	157.2	39.2	22	215.4	53.7	82	273.6	68.2
43	41.7	10.4	03	99.9	24.9	63	158.2	39.4	23	216.4	53.9	83	274.6	68.5
44	42.7	10.6	04	100.9	25.2	64	159.1	39.7	24	217.3	54.2	84	275.6	68.7
45	43.7	10.9	05	101.9	25.4	65	160.1	39.9	25	218.3	54.4	85	276.5	68.9
46	44.6	11.1	06	102.9	25.6	66	161.1	40.2	26	219.3	54.7	86	277.5	69.2
47	45.6	11.4	07	103.8	25.9	67	162.0	40.4	27	220.3	54.9	87	278.5	69.4
48	46.6	11.6	08	104.8	26.1	68	163.0	40.6	28	221.2	55.2	88	279.4	69.7
49	47.5	11.9	09	105.8	26.4	69	164.0	40.9	29	222.2	55.4	89	280.4	69.9
50	48.5	12.1	10	106.7	26.6	70	165.0	41.1	30	223.2	55.6	90	281.4	70.2
51	49.5	12.3	111	107.7	26.9	171	165.9	41.4	231	224.1	55.9	291	282.4	70.4
52	50.5	12.6	12	108.7	27.1	72	166.9	41.6	32	225.1	56.1	92	283.3	70.6
53	51.4	12.8	13	109.6	27.3	73	167.9	41.9	33	226.1	56.4	93	284.3	70.9
54	52.4	13.1	14	110.6	27.6	74	168.8	42.1	34	227.0	56.6	94	285.3	71.1
55	53.4	13.3	15	111.6	27.8	75	169.8	42.3	35	228.0	56.9	95	286.2	71.4
56	54.3	13.5	16	112.6	28.1	76	170.8	42.6	36	229.0	57.1	96	287.2	71.6
57	55.3	13.8	17	113.5	28.3	77	171.7	42.8	37	230.0	57.3	97	288.2	71.9
58	56.3	14.0	18	114.5	28.5	78	172.7	43.1	38	230.9	57.6	98	289.1	72.1
59	57.2	14.3	19	115.5	28.8	79	173.7	43.3	39	231.9	57.8	99	290.1	72.3
60	58.2	14.5	20	116.4	29.0	80	174.7	43.5	40	232.9	58.1	300	291.1	72.6

Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

[For 76 Degrees.

DIFFERENCE OF LATITUDE AND DEPARTURE FOR 15°.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist	Lat.	Dep.	Dist.	Lat.	Dep.
1	1.0	0.3	61	58.9	15.8	121	116.9	31.3	181	174.8	46.8	241	232.8	62.4
2	1.9	0.5	62	59.9	16.0	22	117.8	31.6	82	175.8	47.1	42	233.8	62.6
3	2.9	0.8	63	60.9	16.3	23	118.8	31.8	83	176.8	47.4	43	234.7	62.9
4	3.9	1.0	64	61.8	16.6	24	119.8	32.1	84	177.7	47.6	44	235.7	63.2
5	4.8	1.3	65	62.8	16.8	25	120.7	32.4	85	178.7	47.9	45	236.7	63.4
6	5.8	1.6	66	63.8	17.1	26	121.7	32.6	86	179.7	48.1	46	237.6	63.7
7	6.8	1.8	67	64.7	17.3	27	122.7	32.9	87	180.6	48.4	47	238.6	63.9
8	7.7	2.1	68	65.7	17.6	28	123.6	33.1	88	181.6	48.7	48	239.5	64.2
9	8.7	2.3	69	66.6	17.9	29	124.6	33.4	89	182.6	48.9	49	240.5	64.4
10	9.7	2.6	70	67.6	18.1	30	125.6	33.6	90	183.5	49.2	50	241.5	64.7
11	10.6	2.8	71	68.6	18.4	131	126.5	33.9	191	184.5	49.4	251	242.4	65.0
12	11.6	3.1	72	69.5	18.6	32	127.5	34.2	92	185.5	49.7	52	243.4	65.2
13	12.6	3.4	73	70.5	18.9	33	128.5	34.4	93	186.4	50.0	53	244.4	65.5
14	13.5	3.6	74	71.5	19.2	34	129.4	34.7	94	187.4	50.2	54	245.3	65.7
15	14.5	3.9	75	72.4	19.4	35	130.4	34.9	95	188.4	50.5	55	246.3	66.0
16	15.5	4.1	76	73.4	19.7	36	131.4	35.2	96	189.3	50.7	56	247.3	66.3
17	16.4	4.4	77	74.4	19.9	37	132.3	35.5	97	190.3	51.0	57	248.2	66.5
18	17.4	4.7	78	75.3	20.2	38	133.3	35.7	98	191.3	51.2	58	249.2	66.8
19	18.4	4.9	79	76.3	20.4	39	134.3	36.0	99	192.2	51.5	59	250.2	67.0
20	19.3	5.2	80	77.3	20.7	40	135.2	36.2	200	193.2	51.8	60	251.1	67.3
21	20.3	5.4	81	78.2	21.0	141	136.2	36.5	201	194.2	52.0	261	252.1	67.6
22	21.3	5.7	82	79.2	21.2	42	137.2	36.8	02	195.1	52.3	62	253.1	67.8
23	22.2	6.0	83	80.2	21.5	43	138.1	37.0	03	196.1	52.5	63	254.0	68.1
24	23.2	6.2	84	81.1	21.7	44	139.1	37.3	04	197.0	52.8	64	255.0	68.3
25	24.1	6.5	85	82.1	22.0	45	140.1	37.5	05	198.0	53.1	65	256.0	68.6
26	25.1	6.7	86	83.1	22.3	46	141.0	37.8	06	199.0	53.3	66	256.9	68.8
27	26.1	7.0	87	84.0	22.5	47	142.0	38.0	07	199.9	53.6	67	257.9	69.1
28	27.0	7.2	88	85.0	22.8	48	143.0	38.3	08	200.9	53.8	68	258.9	69.4
29	28.0	7.5	89	86.0	23.0	49	143.9	38.6	09	201.9	54.1	69	259.8	69.6
30	29.0	7.8	90	86.9	23.3	50	144.9	38.8	10	202.8	54.4	70	260.8	69.9
31	29.9	8.0	91	87.9	23.6	151	145.9	39.1	211	203.8	54.6	271	261.8	70.1
32	30.9	8.3	92	88.9	23.8	52	146.8	39.3	12	204.8	54.9	72	262.7	70.4
33	31.9	8.5	93	89.8	24.1	53	147.8	39.6	13	205.7	55.1	73	263.7	70.7
34	32.8	8.8	94	90.8	24.3	54	148.8	39.9	14	206.7	55.4	74	264.7	70.9
35	33.8	9.1	95	91.8	24.6	55	149.7	40.1	15	207.7	55.6	75	265.6	71.2
36	34.8	9.3	96	92.7	24.8	56	150.7	40.4	16	208.6	55.9	76	266.6	71.4
37	35.7	9.6	97	93.7	25.1	57	151.7	40.6	17	209.6	56.2	77	267.6	71.7
38	36.7	9.8	98	94.7	25.4	58	152.6	40.9	18	210.6	56.4	78	268.5	72.0
39	37.7	10.1	99	95.6	25.6	59	153.6	41.2	19	211.5	56.7	79	269.5	72.2
40	38.6	10.4	100	96.6	25.9	60	154.5	41.4	20	212.5	56.9	80	270.5	72.5
41	39.6	10.6	101	97.6	26.1	161	155.5	41.7	221	213.5	57.2	281	271.4	72.7
42	40.6	10.9	02	98.5	26.4	62	156.5	41.9	22	214.4	57.5	82	272.4	73.0
43	41.5	11.1	03	99.5	26.7	63	157.4	42.2	23	215.4	57.7	83	273.4	73.2
44	42.5	11.4	04	100.5	26.9	64	158.4	42.4	24	216.4	58.0	84	274.3	73.5
45	43.5	11.6	05	101.4	27.2	65	159.4	42.7	25	217.3	58.2	85	275.3	73.8
46	44.4	11.9	06	102.4	27.4	66	160.3	43.0	26	218.3	58.5	86	276.3	74.0
47	45.4	12.2	07	103.4	27.7	67	161.3	43.2	27	219.3	58.8	87	277.2	74.3
48	46.4	12.4	08	104.3	28.0	68	162.3	43.5	28	220.2	59.0	88	278.2	74.5
49	47.3	12.7	09	105.3	28.2	69	163.2	43.7	29	221.2	59.3	89	279.2	74.8
50	48.3	12.9	10	106.3	28.5	70	164.2	44.0	30	222.2	59.5	90	280.1	75.1
51	49.3	13.2	111	107.2	28.7	171	165.2	44.3	231	223.1	59.8	291	281.1	75.3
52	50.2	13.5	12	108.2	29.0	72	166.1	44.5	32	224.1	60.0	92	282.1	75.6
53	51.2	13.7	13	109.1	29.2	73	167.1	44.8	33	225.1	60.3	93	283.0	75.8
54	52.2	14.0	14	110.1	29.5	74	168.1	45.0	34	226.0	60.6	94	284.0	76.1
55	53.1	14.2	15	111.1	29.8	75	169.0	45.3	35	227.0	60.8	95	284.9	76.4
56	54.1	14.5	16	112.0	30.0	76	170.0	45.6	36	228.0	61.1	96	285.9	76.6
57	55.1	14.8	17	113.0	30.3	77	171.0	45.8	37	228.9	61.3	97	286.9	76.9
58	56.0	15.0	18	114.0	30.5	78	171.9	46.1	38	229.9	61.6	98	287.8	77.1
59	57.0	15.3	19	114.9	30.8	79	172.9	46.3	39	230.9	61.9	99	288.8	77.4
60	58.0	15.5	20	115.9	31.1	80	173.9	46.6	40	231.8	62.1	300	289.8	77.6

Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

[For 75 Degrees.

DIFFERENCE OF LATITUDE AND DEPARTURE FOR 16°.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	1.0	0.3	61	58.6	16.8	121	116.3	33.4	181	174.0	49.9	241	231.7	66.4
2	1.9	0.6	62	59.6	17.1	22	117.3	33.6	82	174.9	50.2	42	232.6	66.7
3	2.9	0.8	63	60.6	17.4	23	118.2	33.9	83	175.9	50.4	43	233.6	67.0
4	3.8	1.1	64	61.5	17.6	24	119.2	34.2	84	176.9	50.7	44	234.5	67.3
5	4.8	1.4	65	62.5	17.9	25	120.2	34.5	85	177.8	51.0	45	235.5	67.5
6	5.8	1.7	66	63.4	18.2	26	121.1	34.7	86	178.8	51.3	46	236.5	67.8
7	6.7	1.9	67	64.4	18.5	27	122.1	35.0	87	179.8	51.5	47	237.4	68.1
8	7.7	2.2	68	65.4	18.7	28	123.0	35.3	88	180.7	51.8	48	238.4	68.4
9	8.7	2.5	69	66.3	19.0	29	124.0	35.6	89	181.7	52.1	49	239.4	68.6
10	9.6	2.8	70	67.3	19.3	30	125.0	35.8	90	182.6	52.4	50	240.3	68.9
11	10.6	3.0	71	68.2	19.6	131	125.9	36.1	191	183.6	52.6	251	241.3	69.2
12	11.5	3.3	72	69.2	19.8	32	126.9	36.4	92	184.6	52.9	52	242.2	69.5
13	12.5	3.6	73	70.2	20.1	33	127.8	36.7	93	185.5	53.2	53	243.2	69.7
14	13.5	3.9	74	71.1	20.4	34	128.8	36.9	94	186.5	53.5	54	244.2	70.0
15	14.4	4.1	75	72.1	20.7	35	129.8	37.2	95	187.4	53.7	55	245.1	70.3
16	15.4	4.4	76	73.1	20.9	36	130.7	37.5	96	188.4	54.0	56	246.1	70.6
17	16.3	4.7	77	74.0	21.2	37	131.7	37.8	97	189.4	54.3	57	247.0	70.8
18	17.3	5.0	78	75.0	21.5	38	132.7	38.0	98	190.3	54.6	58	248.0	71.1
19	18.3	5.2	79	75.9	21.8	39	133.6	38.3	99	191.3	54.9	59	249.0	71.4
20	19.2	5.5	80	76.9	22.1	40	134.6	38.6	200	192.3	55.1	60	249.9	71.7
21	20.2	5.8	81	77.9	22.3	141	135.5	38.9	201	193.2	55.4	261	250.9	71.9
22	21.1	6.1	82	78.8	22.6	42	136.5	39.1	02	194.2	55.7	62	251.9	72.2
23	22.1	6.3	83	79.8	22.9	43	137.5	39.4	03	195.1	56.0	63	252.8	72.5
24	23.1	6.6	84	80.7	23.2	44	138.4	39.7	04	196.1	56.2	64	253.8	72.8
25	24.0	6.9	85	81.7	23.4	45	139.4	40.0	05	197.1	56.5	65	254.7	73.0
26	25.0	7.2	86	82.7	23.7	46	140.3	40.2	06	198.0	56.8	66	255.7	73.3
27	26.0	7.4	87	83.6	24.0	47	141.3	40.5	07	199.0	57.1	67	256.7	73.6
28	26.9	7.7	88	84.6	24.3	48	142.3	40.8	08	199.9	57.3	68	257.6	73.9
29	27.9	8.0	89	85.6	24.5	49	143.2	41.1	09	200.9	57.6	69	258.6	74.1
30	28.8	8.3	90	86.5	24.8	50	144.2	41.3	10	201.9	57.9	70	259.5	74.4
31	29.8	8.5	91	87.5	25.1	151	145.2	41.6	211	202.8	58.2	271	260.5	74.7
32	30.8	8.8	92	88.4	25.4	52	146.1	41.9	12	203.8	58.4	72	261.5	75.0
33	31.7	9.1	93	89.4	25.6	53	147.1	42.2	13	204.7	58.7	73	262.4	75.2
34	32.7	9.4	94	90.4	25.9	54	148.0	42.4	14	205.7	59.0	74	263.4	75.5
35	33.6	9.6	95	91.3	26.2	55	149.0	42.7	15	206.7	59.3	75	264.3	75.8
36	34.6	9.9	96	92.3	26.5	56	150.0	43.0	16	207.6	59.5	76	265.3	76.1
37	35.6	10.2	97	93.2	26.7	57	150.9	43.3	17	208.6	59.8	77	266.3	76.4
38	36.5	10.5	98	94.2	27.0	58	151.9	43.6	18	209.6	60.1	78	267.2	76.6
39	37.5	10.7	99	95.2	27.3	59	152.8	43.8	19	210.5	60.4	79	268.2	76.9
40	38.5	11.0	100	96.1	27.6	60	153.8	44.1	20	211.5	60.6	80	269.2	77.2
41	39.4	11.3	101	97.1	27.8	161	154.8	44.4	221	212.4	60.9	281	270.1	77.5
42	40.4	11.6	02	98.0	28.1	62	155.7	44.7	22	213.4	61.2	82	271.1	77.7
43	41.3	11.9	03	99.0	28.4	63	156.7	44.9	23	214.4	61.5	83	272.0	78.0
44	42.3	12.1	04	100.0	28.7	64	157.6	45.2	24	215.3	61.7	84	273.0	78.3
45	43.3	12.4	05	100.9	28.9	65	158.6	45.5	25	216.3	62.0	85	274.0	78.6
46	44.2	12.7	06	101.9	29.2	66	159.6	45.8	26	217.2	62.3	86	274.9	78.8
47	45.2	13.0	07	102.9	29.5	67	160.5	46.0	27	218.2	62.6	87	275.9	79.1
48	46.1	13.2	08	103.8	29.8	68	161.5	46.3	28	219.2	62.8	88	276.8	79.4
49	47.1	13.5	09	104.8	30.0	69	162.5	46.6	29	220.1	63.1	89	277.8	79.7
50	48.1	13.8	10	105.7	30.3	70	163.4	46.9	30	221.1	63.4	90	278.8	79.9
51	49.0	14.1	111	106.7	30.6	171	164.4	47.1	231	222.1	63.7	291	279.7	80.2
52	50.0	14.3	12	107.7	30.9	72	165.3	47.4	32	223.0	63.9	92	280.7	80.5
53	50.9	14.6	13	108.6	31.1	73	166.3	47.7	33	224.0	64.2	93	281.6	80.8
54	51.9	14.9	14	109.6	31.4	74	167.3	48.0	34	224.9	64.5	94	282.6	81.0
55	52.9	15.2	15	110.5	31.7	75	168.2	48.2	35	225.9	64.8	95	283.6	81.3
56	53.8	15.4	16	111.5	32.0	76	169.2	48.5	36	226.9	65.1	96	284.5	81.6
57	54.8	15.7	17	112.5	32.2	77	170.1	48.8	37	227.8	65.3	97	285.5	81.9
58	55.8	16.0	18	113.4	32.5	78	171.1	49.1	38	228.8	65.6	98	286.5	82.1
59	56.7	16.3	19	114.4	32.8	79	172.1	49.3	39	229.7	65.9	99	287.4	82.4
60	57.7	16.5	20	115.4	33.1	80	173.0	49.6	40	230.7	66.2	300	288.4	82.7

Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

[For 74 Degrees.

DIFFERENCE OF LATITUDE AND DEPARTURE FOR 17°.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	1.0	0.3	61	58.3	17.8	121	115.7	35.4	181	173.1	52.9	241	230.5	70.5
2	1.9	0.6	62	59.3	18.1	122	116.7	35.7	182	174.0	53.2	242	231.4	70.8
3	2.9	0.9	63	60.2	18.4	123	117.6	36.0	183	175.0	53.5	243	232.4	71.0
4	3.8	1.2	64	61.2	18.7	124	118.6	36.3	184	176.0	53.8	244	233.3	71.3
5	4.8	1.5	65	62.2	19.0	25	119.5	36.5	185	176.9	54.1	45	234.3	71.6
6	5.7	1.8	66	63.1	19.3	26	120.5	36.8	186	177.9	54.4	46	235.3	71.9
7	6.7	2.0	67	64.1	19.6	27	121.5	37.1	187	178.8	54.7	47	236.2	72.2
8	7.7	2.3	68	65.0	19.9	28	122.4	37.4	188	179.8	55.0	48	237.2	72.5
9	8.6	2.6	69	66.0	20.2	29	123.4	37.7	189	180.7	55.3	49	238.1	72.8
10	9.6	2.9	70	66.9	20.5	30	124.3	38.0	90	181.7	55.6	50	239.1	73.1
11	10.5	3.2	71	67.9	20.8	131	125.3	38.3	191	182.7	55.8	251	240.0	73.4
12	11.5	3.5	72	68.9	21.1	32	126.2	38.6	92	183.6	56.1	52	241.0	73.7
13	12.4	3.8	73	69.8	21.3	33	127.2	38.9	93	184.6	56.4	53	241.9	74.0
14	13.4	4.1	74	70.8	21.6	34	128.1	39.2	94	185.5	56.7	54	242.9	74.3
15	14.3	4.4	75	71.7	21.9	35	129.1	39.5	95	186.5	57.0	55	243.9	74.6
16	15.3	4.7	76	72.7	22.2	36	130.1	39.8	96	187.4	57.3	56	244.8	74.8
17	16.3	5.0	77	73.6	22.5	37	131.0	40.1	97	188.4	57.6	57	245.8	75.1
18	17.2	5.3	78	74.6	22.8	38	132.0	40.3	98	189.3	57.9	58	246.7	75.4
19	18.2	5.6	79	75.5	23.1	39	132.9	40.6	99	190.3	58.2	59	247.7	75.7
20	19.1	5.8	80	76.5	23.4	40	133.9	40.9	200	191.3	58.5	60	248.6	76.0
21	20.1	6.1	81	77.5	23.7	141	134.8	41.2	201	192.2	58.8	261	249.6	76.3
22	21.0	6.4	82	78.4	24.0	42	135.8	41.5	02	193.2	59.1	62	250.6	76.6
23	22.0	6.7	83	79.4	24.3	43	136.8	41.8	03	194.1	59.4	63	251.5	76.9
24	23.0	7.0	84	80.3	24.6	44	137.7	42.1	04	195.1	59.6	64	252.5	77.2
25	23.9	7.3	85	81.3	24.9	45	138.7	42.4	05	196.0	59.9	65	253.4	77.5
26	24.9	7.6	86	82.2	25.1	46	139.6	42.7	06	197.0	60.2	66	254.4	77.8
27	25.8	7.9	87	83.2	25.4	47	140.6	43.0	07	198.0	60.5	67	255.3	78.1
28	26.8	8.2	88	84.2	25.7	48	141.5	43.3	08	198.9	60.8	68	256.3	78.4
29	27.7	8.5	89	85.1	26.0	49	142.5	43.6	09	199.9	61.1	69	257.2	78.6
30	28.7	8.8	90	86.1	26.3	50	143.4	43.9	10	200.8	61.4	70	258.2	78.9
31	29.6	9.1	91	87.0	26.6	151	144.4	44.1	211	201.8	61.7	271	259.2	79.2
32	30.6	9.4	92	88.0	26.9	52	145.4	44.4	12	202.7	62.0	72	260.1	79.5
33	31.6	9.6	93	88.9	27.2	53	146.3	44.7	13	203.7	62.3	73	261.1	79.8
34	32.5	9.9	94	89.9	27.5	54	147.3	45.0	14	204.6	62.6	74	262.0	80.1
35	33.5	10.2	95	90.8	27.8	55	148.2	45.3	15	205.6	62.9	75	263.0	80.4
36	34.4	10.5	96	91.8	28.1	56	149.2	45.6	16	206.6	63.2	76	263.9	80.7
37	35.4	10.8	97	92.8	28.4	57	150.1	45.9	17	207.5	63.4	77	264.9	81.0
38	36.3	11.1	98	93.7	28.7	58	151.1	46.2	18	208.5	63.7	78	265.9	81.3
39	37.3	11.4	99	94.7	28.9	59	152.1	46.5	19	209.4	64.0	79	266.8	81.6
40	38.3	11.7	100	95.6	29.2	60	153.0	46.8	20	210.4	64.3	80	267.8	81.9
41	39.2	12.0	101	96.6	29.5	161	154.0	47.1	221	211.3	64.6	281	268.7	82.2
42	40.2	12.3	02	97.5	29.8	62	154.9	47.4	22	212.3	64.9	82	269.7	82.4
43	41.1	12.6	03	98.5	30.1	63	155.9	47.7	23	213.3	65.2	83	270.6	82.7
44	42.1	12.9	04	99.5	30.4	64	156.8	47.9	24	214.2	65.5	84	271.6	83.0
45	43.0	13.2	05	100.4	30.7	65	157.8	48.2	25	215.2	65.8	85	272.5	83.3
46	44.0	13.4	06	101.4	31.0	66	158.7	48.5	26	216.1	66.1	86	273.5	83.6
47	44.9	13.7	07	102.3	31.3	67	159.7	48.8	27	217.1	66.4	87	274.5	83.9
48	45.9	14.0	08	103.3	31.6	68	160.7	49.1	28	218.0	66.7	88	275.4	84.2
49	46.9	14.3	09	104.2	31.9	69	161.6	49.4	29	219.0	67.0	89	276.4	84.5
50	47.8	14.6	10	105.2	32.2	70	162.6	49.7	30	220.0	67.2	90	277.3	84.8
51	48.8	14.9	111	106.1	32.5	171	163.5	50.0	231	220.9	67.5	291	278.3	85.1
52	49.7	15.2	12	107.1	32.7	72	164.5	50.3	32	221.9	67.8	92	279.2	85.4
53	50.7	15.5	13	108.1	33.0	73	165.4	50.6	33	222.8	68.1	93	280.2	85.7
54	51.6	15.8	14	109.0	33.3	74	166.4	50.9	34	223.8	68.4	94	281.2	86.0
55	52.6	16.1	15	110.0	33.6	75	167.4	51.2	35	224.7	68.7	95	282.1	86.2
56	53.6	16.4	16	110.9	33.9	76	168.3	51.5	36	225.7	69.0	96	283.1	86.5
57	54.5	16.7	17	111.9	34.2	77	169.3	51.7	37	226.6	69.3	97	284.0	86.8
58	55.5	17.0	18	112.8	34.5	78	170.2	52.0	38	227.6	69.6	98	285.0	87.1
59	56.4	17.2	19	113.8	34.8	79	171.2	52.3	39	228.6	69.9	99	285.9	87.4
60	57.4	17.5	20	114.8	35.1	80	172.1	52.6	40	229.5	70.2	300	286.9	87.7

Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

[For 73 Degrees.

DIFFERENCE OF LATITUDE AND DEPARTURE FOR 18°.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	1.0	0.3	61	58.0	18.9	121	115.1	37.4	181	172.1	55.9	241	229.2	74.5
2	1.9	0.6	62	59.0	19.2	22	116.0	37.7	82	173.1	56.2	42	230.2	74.8
3	2.9	0.9	63	59.9	19.5	23	117.0	38.0	83	174.0	56.6	43	231.1	75.1
4	3.8	1.2	64	60.9	19.8	24	117.9	38.3	84	175.0	56.9	44	232.1	75.4
5	4.8	1.5	65	61.8	20.1	25	118.9	38.6	85	175.9	57.2	45	233.0	75.7
6	5.7	1.9	66	62.8	20.4	26	119.8	38.9	86	176.9	57.5	46	234.0	76.0
7	6.7	2.2	67	63.7	20.7	27	120.8	39.2	87	177.8	57.8	47	234.9	76.3
8	7.6	2.5	68	64.7	21.0	28	121.7	39.6	88	178.8	58.1	48	235.9	76.6
9	8.6	2.8	69	65.6	21.3	29	122.7	39.9	89	179.7	58.4	49	236.8	76.9
10	9.5	3.1	70	66.6	21.6	30	123.6	40.2	90	180.7	58.7	50	237.8	77.3
11	10.5	3.4	71	67.5	21.9	131	124.6	40.5	191	181.7	59.0	251	238.7	77.6
12	11.4	3.7	72	68.5	22.2	32	125.5	40.8	92	182.6	59.3	52	239.7	77.9
13	12.4	4.0	73	69.4	22.6	33	126.5	41.1	93	183.6	59.6	53	240.6	78.2
14	13.3	4.3	74	70.4	22.9	34	127.4	41.4	94	184.5	59.9	54	241.6	78.5
15	14.3	4.6	75	71.3	23.2	35	128.4	41.7	95	185.5	60.3	55	242.5	78.8
16	15.2	4.9	76	72.3	23.5	36	129.3	42.0	96	186.4	60.6	56	243.5	79.1
17	16.2	5.3	77	73.2	23.8	37	130.3	42.3	97	187.4	60.9	57	244.4	79.4
18	17.1	5.6	78	74.2	24.1	38	131.2	42.6	98	188.3	61.2	58	245.4	79.7
19	18.1	5.9	79	75.1	24.4	39	132.2	43.0	99	189.3	61.5	59	246.3	80.0
20	19.0	6.2	80	76.1	24.7	40	133.1	43.3	200	190.2	61.8	60	247.3	80.3
21	20.0	6.5	81	77.0	25.0	141	134.1	43.6	201	191.2	62.1	261	248.2	80.7
22	20.9	6.8	82	78.0	25.3	42	135.1	43.9	02	192.1	62.4	62	249.2	81.0
23	21.9	7.1	83	78.9	25.6	43	136.0	44.2	03	193.1	62.7	63	250.1	81.3
24	22.8	7.4	84	79.9	26.0	44	137.0	44.5	04	194.0	63.0	64	251.1	81.6
25	23.8	7.7	85	80.8	26.3	45	137.9	44.8	05	195.0	63.3	65	252.0	81.9
26	24.7	8.0	86	81.8	26.6	46	138.9	45.1	06	195.9	63.7	66	253.0	82.2
27	25.7	8.3	87	82.7	26.9	47	139.8	45.4	07	196.9	64.0	67	253.9	82.5
28	26.6	8.7	88	83.7	27.2	48	140.8	45.7	08	197.8	64.3	68	254.9	82.8
29	27.6	9.0	89	84.6	27.5	49	141.7	46.0	09	198.8	64.6	69	255.8	83.1
30	28.5	9.3	90	85.6	27.8	50	142.7	46.4	10	199.7	64.9	70	256.8	83.4
31	29.5	9.6	91	86.5	28.1	151	143.6	46.7	211	200.7	65.2	271	257.7	83.7
32	30.4	9.9	92	87.5	28.4	52	144.6	47.0	12	201.6	65.5	72	258.7	84.1
33	31.4	10.2	93	88.4	28.7	53	145.5	47.3	13	202.6	65.8	73	259.6	84.4
34	32.3	10.5	94	89.4	29.0	54	146.5	47.6	14	203.5	66.1	74	260.6	84.7
35	33.3	10.8	95	90.4	29.4	55	147.4	47.9	15	204.5	66.4	75	261.5	85.0
36	34.2	11.1	96	91.3	29.7	56	148.4	48.2	16	205.4	66.7	76	262.5	85.3
37	35.2	11.4	97	92.3	30.0	57	149.3	48.5	17	206.4	67.1	77	263.4	85.6
38	36.1	11.7	98	93.2	30.3	58	150.3	48.8	18	207.3	67.4	78	264.4	85.9
39	37.1	12.1	99	94.2	30.6	59	151.2	49.1	19	208.3	67.7	79	265.3	86.2
40	38.0	12.4	100	95.1	30.9	60	152.2	49.4	20	209.2	68.0	80	266.3	86.5
41	39.0	12.7	101	96.1	31.2	161	153.1	49.8	221	210.2	68.3	281	267.2	86.8
42	39.9	13.0	02	97.0	31.5	62	154.1	50.1	22	211.1	68.6	82	268.2	87.1
43	40.9	13.3	03	98.0	31.8	63	155.0	50.4	23	212.1	68.9	83	269.1	87.5
44	41.8	13.6	04	98.9	32.1	64	156.0	50.7	24	213.0	69.2	84	270.1	87.8
45	42.8	13.9	05	99.9	32.4	65	156.9	51.0	25	214.0	69.5	85	271.1	88.1
46	43.7	14.2	06	100.8	32.8	66	157.9	51.3	26	214.9	69.8	86	272.0	88.4
47	44.7	14.5	07	101.8	33.1	67	158.8	51.6	27	215.9	70.1	87	273.0	88.7
48	45.7	14.8	08	102.7	33.4	68	159.8	51.9	28	216.8	70.5	88	273.9	89.0
49	46.6	15.1	09	103.7	33.7	69	160.7	52.2	29	217.8	70.8	89	274.9	89.3
50	47.6	15.5	10	104.6	34.0	70	161.7	52.5	30	218.7	71.1	90	275.8	89.6
51	48.5	15.8	111	105.6	34.3	171	162.6	52.8	231	219.7	71.4	291	276.8	89.9
52	49.5	16.1	12	106.5	34.6	72	163.6	53.2	32	220.6	71.7	92	277.7	90.2
53	50.4	16.4	13	107.5	34.9	73	164.5	53.5	33	221.6	72.0	93	278.7	90.5
54	51.4	16.7	14	108.4	35.2	74	165.5	53.8	34	222.5	72.3	94	279.6	90.9
55	52.3	17.0	15	109.4	35.5	75	166.4	54.1	35	223.5	72.6	95	280.6	91.2
56	53.3	17.3	16	110.3	35.8	76	167.4	54.4	36	224.4	72.9	96	281.5	91.5
57	54.2	17.6	17	111.3	36.2	77	168.3	54.7	37	225.4	73.2	97	282.5	91.8
58	55.2	17.9	18	112.2	36.5	78	169.3	55.0	38	226.4	73.5	98	283.4	92.1
59	56.1	18.2	19	113.2	36.8	79	170.2	55.3	39	227.3	73.9	99	284.4	92.4
60	57.1	18.5	20	114.1	37.1	80	171.2	55.6	40	228.3	74.2	300	285.3	92.7

Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

[For 72 Degrees.

DIFFERENCE OF LATITUDE AND DEPARTURE FOR 19°.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	0. 9	0. 3	61	57. 7	19. 9	121	114. 4	39. 4	181	171. 1	58. 9	241	227. 9	78. 5
2	1. 9	0. 7	62	58. 6	20. 2	22	115. 4	39. 7	82	172. 1	59. 3	42	228. 8	78. 8
3	2. 8	1. 0	63	59. 6	20. 5	23	116. 3	40. 0	83	173. 0	59. 6	43	229. 8	79. 1
4	3. 8	1. 3	64	60. 5	20. 8	24	117. 2	40. 4	84	174. 0	59. 9	44	230. 7	79. 4
5	4. 7	1. 6	65	61. 5	21. 2	25	118. 2	40. 7	85	174. 9	60. 2	45	231. 7	79. 8
6	5. 7	2. 0	66	62. 4	21. 5	26	119. 1	41. 0	86	175. 9	60. 6	46	232. 6	80. 1
7	6. 6	2. 3	67	63. 3	21. 8	27	120. 1	41. 3	87	176. 8	60. 9	47	233. 5	80. 4
8	7. 6	2. 6	68	64. 3	22. 1	28	121. 0	41. 7	88	177. 8	61. 2	48	234. 5	80. 7
9	8. 5	2. 9	69	65. 2	22. 5	29	122. 0	42. 0	89	178. 7	61. 5	49	235. 4	81. 1
10	9. 5	3. 3	70	66. 2	22. 8	30	122. 9	42. 3	90	179. 6	61. 9	50	236. 4	81. 4
11	10. 4	3. 6	71	67. 1	23. 1	131	123. 9	42. 6	191	180. 6	62. 2	251	237. 3	81. 7
12	11. 3	3. 9	72	68. 1	23. 4	32	124. 8	43. 0	92	181. 5	62. 5	52	238. 3	82. 0
13	12. 3	4. 2	73	69. 0	23. 8	33	125. 8	43. 3	93	182. 5	62. 8	53	239. 2	82. 4
14	13. 2	4. 6	74	70. 0	24. 1	34	126. 7	43. 6	94	183. 4	63. 2	54	240. 2	82. 7
15	14. 2	4. 9	75	70. 9	24. 4	35	127. 6	44. 0	95	184. 4	63. 5	55	241. 1	83. 0
16	15. 1	5. 2	76	71. 9	24. 7	36	128. 6	44. 3	96	185. 3	63. 8	56	242. 1	83. 3
17	16. 1	5. 5	77	72. 8	25. 1	37	129. 5	44. 6	97	186. 3	64. 1	57	243. 0	83. 7
18	17. 0	5. 9	78	73. 8	25. 4	38	130. 5	44. 9	98	187. 2	64. 5	58	243. 9	84. 0
19	18. 0	6. 2	79	74. 7	25. 7	39	131. 4	45. 3	99	188. 2	64. 8	59	244. 9	84. 3
20	18. 9	6. 5	80	75. 6	26. 0	40	132. 4	45. 6	200	189. 1	65. 1	60	245. 8	84. 6
21	19. 9	6. 8	81	76. 6	26. 4	141	133. 3	45. 9	201	190. 0	65. 4	261	246. 8	85. 0
22	20. 8	7. 2	82	77. 5	26. 7	42	134. 3	46. 2	02	191. 0	65. 8	62	247. 7	85. 3
23	21. 7	7. 5	83	78. 5	27. 0	43	135. 2	46. 6	03	191. 9	66. 1	63	248. 7	85. 6
24	22. 7	7. 8	84	79. 4	27. 3	44	136. 2	46. 9	04	192. 9	66. 4	64	249. 6	86. 0
25	23. 6	8. 1	85	80. 4	27. 7	45	137. 1	47. 2	05	193. 8	66. 7	65	250. 6	86. 3
26	24. 6	8. 5	86	81. 3	28. 0	46	138. 0	47. 5	06	194. 8	67. 1	66	251. 5	86. 6
27	25. 5	8. 8	87	82. 3	28. 3	47	139. 0	47. 9	07	195. 7	67. 4	67	252. 5	86. 9
28	26. 5	9. 1	88	83. 2	28. 7	48	139. 9	48. 2	08	196. 7	67. 7	68	253. 4	87. 3
29	27. 4	9. 4	89	84. 2	29. 0	49	140. 9	48. 5	09	197. 6	68. 0	69	254. 3	87. 6
30	28. 4	9. 8	90	85. 1	29. 3	50	141. 8	48. 8	10	198. 6	68. 4	70	255. 3	87. 9
31	29. 3	10. 1	91	86. 0	29. 6	151	142. 8	49. 2	211	199. 5	68. 7	271	256. 2	88. 2
32	30. 3	10. 4	92	87. 0	30. 0	52	143. 7	49. 5	12	200. 4	69. 0	72	257. 2	88. 6
33	31. 2	10. 7	93	87. 9	30. 3	53	144. 7	49. 8	13	201. 4	69. 3	73	258. 1	88. 9
34	32. 1	11. 1	94	88. 9	30. 6	54	145. 6	50. 1	14	202. 3	69. 7	74	259. 1	89. 2
35	33. 1	11. 4	95	89. 8	30. 9	55	146. 6	50. 5	15	203. 3	70. 0	75	260. 0	89. 5
36	34. 0	11. 7	96	90. 8	31. 3	56	147. 5	50. 8	16	204. 2	70. 3	76	261. 0	89. 9
37	35. 0	12. 0	97	91. 7	31. 6	57	148. 4	51. 1	17	205. 2	70. 6	77	261. 9	90. 2
38	35. 9	12. 4	98	92. 7	31. 9	58	149. 4	51. 4	18	206. 1	71. 0	78	262. 9	90. 5
39	36. 9	12. 7	99	93. 6	32. 2	59	150. 3	51. 8	19	207. 1	71. 3	79	263. 8	90. 8
40	37. 8	13. 0	100	94. 6	32. 6	60	151. 3	52. 1	20	208. 0	71. 6	80	264. 7	91. 2
41	38. 8	13. 3	101	95. 5	32. 9	161	152. 2	52. 4	221	209. 0	72. 0	281	265. 7	91. 5
42	39. 7	13. 7	02	96. 4	33. 2	62	153. 2	52. 7	22	209. 9	72. 3	82	266. 6	91. 8
43	40. 7	14. 0	03	97. 4	33. 5	63	154. 1	53. 1	23	210. 9	72. 6	83	267. 6	92. 1
44	41. 6	14. 3	04	98. 3	33. 9	64	155. 1	53. 4	24	211. 8	72. 9	84	268. 5	92. 5
45	42. 5	14. 7	05	99. 3	34. 2	65	156. 0	53. 7	25	212. 7	73. 3	85	269. 5	92. 8
46	43. 5	15. 0	06	100. 2	34. 5	66	157. 0	54. 0	26	213. 7	73. 6	86	270. 4	93. 1
47	44. 4	15. 3	07	101. 2	34. 8	67	157. 9	54. 4	27	214. 6	73. 9	87	271. 4	93. 4
48	45. 4	15. 6	08	102. 1	35. 2	68	158. 8	54. 7	28	215. 6	74. 2	88	272. 3	93. 8
49	46. 3	16. 0	09	103. 1	35. 5	69	159. 8	55. 0	29	216. 5	74. 6	89	273. 3	94. 1
50	47. 3	16. 3	10	104. 0	35. 8	70	160. 7	55. 3	30	217. 5	74. 9	90	274. 2	94. 4
51	48. 2	16. 6	111	105. 0	36. 1	171	161. 7	55. 7	231	218. 4	75. 2	291	275. 1	94. 7
52	49. 2	16. 9	12	105. 9	36. 5	72	162. 6	56. 0	32	219. 4	75. 5	92	276. 1	95. 1
53	50. 1	17. 3	13	106. 8	36. 8	73	163. 6	56. 3	33	220. 3	75. 9	93	277. 0	95. 4
54	51. 1	17. 6	14	107. 8	37. 1	74	164. 5	56. 6	34	221. 3	76. 2	94	278. 0	95. 7
55	52. 0	17. 9	15	108. 7	37. 4	75	165. 5	57. 0	35	222. 2	76. 5	95	278. 9	96. 0
56	52. 9	18. 2	16	109. 7	37. 8	76	166. 4	57. 3	36	223. 1	76. 8	96	279. 9	96. 4
57	53. 9	18. 6	17	110. 6	38. 1	77	167. 4	57. 6	37	224. 1	77. 2	97	280. 8	96. 7
58	54. 8	18. 9	18	111. 6	38. 4	78	168. 3	58. 0	38	225. 0	77. 5	98	281. 8	97. 0
59	55. 8	19. 2	19	112. 5	38. 7	79	169. 2	58. 3	39	226. 0	77. 8	99	282. 7	97. 3
60	56. 7	19. 5	20	113. 5	39. 1	80	170. 2	58. 6	40	226. 9	78. 1	300	283. 7	97. 7
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

[For 71 Degrees.

DIFFERENCE OF LATITUDE AND DEPARTURE FOR 20°.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	0.9	0.3	61	57.3	20.9	121	113.7	41.4	181	170.1	61.9	241	226.5	82.4
2	1.9	0.7	62	58.3	21.2	22	114.6	41.7	82	171.0	62.2	42	227.4	82.8
3	2.8	1.0	63	59.2	21.5	23	115.6	42.1	83	172.0	62.6	43	228.3	83.1
4	3.8	1.4	64	60.1	21.9	24	116.5	42.4	84	172.9	62.9	44	229.3	83.5
5	4.7	1.7	65	61.1	22.2	25	117.5	42.8	85	173.8	63.3	45	230.2	83.8
6	5.6	2.1	66	62.0	22.6	26	118.4	43.1	86	174.8	63.6	46	231.2	84.1
7	6.6	2.4	67	63.0	22.9	27	119.3	43.4	87	175.7	64.0	47	232.1	84.5
8	7.5	2.7	68	63.9	23.3	28	120.3	43.8	88	176.7	64.3	48	233.0	84.8
9	8.5	3.1	69	64.8	23.6	29	121.2	44.1	89	177.6	64.6	49	234.0	85.2
10	9.4	3.4	70	65.8	23.9	30	122.2	44.5	90	178.5	65.0	50	234.9	85.5
11	10.3	3.8	71	66.7	24.3	131	123.1	44.8	191	179.5	65.3	251	235.9	85.8
12	11.3	4.1	72	67.7	24.6	32	124.0	45.1	92	180.4	65.7	52	236.8	86.2
13	12.2	4.4	73	68.6	25.0	33	125.0	45.5	93	181.4	66.0	53	237.7	86.5
14	13.2	4.8	74	69.5	25.3	34	125.9	45.8	94	182.3	66.4	54	238.7	86.9
15	14.1	5.1	75	70.5	25.7	35	126.9	46.2	95	183.2	66.7	55	239.6	87.2
16	15.0	5.5	76	71.4	26.0	36	127.8	46.5	96	184.2	67.0	56	240.6	87.6
17	16.0	5.8	77	72.4	26.3	37	128.7	46.9	97	185.1	67.4	57	241.5	87.9
18	16.9	6.2	78	73.3	26.7	38	129.7	47.2	98	186.1	67.7	58	242.4	88.2
19	17.9	6.5	79	74.2	27.0	39	130.6	47.5	99	187.0	68.1	59	243.4	88.6
20	18.8	6.8	80	75.2	27.4	40	131.6	47.9	200	187.9	68.4	60	244.3	88.9
21	19.7	7.2	81	76.1	27.7	141	132.5	48.2	201	188.9	68.7	261	245.3	89.3
22	20.7	7.5	82	77.1	28.0	42	133.4	48.6	02	189.8	69.1	62	246.2	89.6
23	21.6	7.9	83	78.0	28.4	43	134.4	48.9	03	190.8	69.4	63	247.1	90.0
24	22.6	8.2	84	78.9	28.7	44	135.3	49.3	04	191.7	69.8	64	248.1	90.3
25	23.5	8.6	85	79.9	29.1	45	136.3	49.6	05	192.6	70.1	65	249.0	90.6
26	24.4	8.9	86	80.8	29.4	46	137.2	49.9	06	193.6	70.5	66	250.0	91.0
27	25.4	9.2	87	81.8	29.8	47	138.1	50.3	07	194.5	70.8	67	250.9	91.3
28	26.3	9.6	88	82.7	30.1	48	139.1	50.6	08	195.5	71.1	68	251.8	91.7
29	27.3	9.9	89	83.6	30.4	49	140.0	51.0	09	196.4	71.5	69	252.8	92.0
30	28.2	10.3	90	84.6	30.8	50	140.0	51.3	10	197.3	71.8	70	253.7	92.3
31	29.1	10.6	91	85.5	31.1	151	141.9	51.6	211	198.3	72.2	271	254.7	92.7
32	30.1	10.9	92	86.5	31.5	52	142.8	52.0	12	199.2	72.5	72	255.6	93.0
33	31.0	11.3	93	87.4	31.8	53	143.8	52.3	13	200.2	72.9	73	256.5	93.4
34	31.9	11.6	94	88.3	32.1	54	144.7	52.7	14	201.1	73.2	74	257.5	93.7
35	32.9	12.0	95	89.3	32.5	55	145.7	53.0	15	202.0	73.5	75	258.4	94.1
36	33.8	12.3	96	90.2	32.8	56	146.6	53.4	16	203.0	73.9	76	259.4	94.4
37	34.8	12.7	97	91.2	33.2	57	147.5	53.7	17	203.9	74.2	77	260.3	94.7
38	35.7	13.0	98	92.1	33.5	58	148.5	54.0	18	204.9	74.6	78	261.2	95.1
39	36.6	13.3	99	93.0	33.9	59	149.4	54.4	19	205.8	74.9	79	262.2	95.4
40	37.6	13.7	100	94.0	34.2	60	150.4	54.7	20	206.7	75.2	80	263.1	95.8
41	38.5	14.0	101	94.9	34.5	161	151.3	55.1	221	207.7	75.6	281	264.1	96.1
42	39.5	14.4	02	95.8	34.9	62	152.2	55.4	22	208.6	75.9	82	265.0	96.4
43	40.4	14.7	03	96.8	35.2	63	153.2	55.7	23	209.6	76.3	83	265.9	96.8
44	41.3	15.0	04	97.7	35.6	64	154.1	56.1	24	210.5	76.6	84	266.9	97.1
45	42.3	15.4	05	98.7	35.9	65	155.0	56.4	25	211.4	77.0	85	267.8	97.5
46	43.2	15.7	06	99.6	36.3	66	156.0	56.8	26	212.4	77.3	86	268.8	97.8
47	44.2	16.1	07	100.5	36.6	67	156.9	57.1	27	213.3	77.6	87	269.7	98.2
48	45.1	16.4	08	101.5	36.9	68	157.9	57.5	28	214.2	78.0	88	270.6	98.5
49	46.0	16.8	09	102.4	37.3	69	158.8	57.8	29	215.2	78.3	89	271.6	98.8
50	47.0	17.1	10	103.4	37.6	70	159.7	58.1	30	216.1	78.7	90	272.5	99.2
51	47.9	17.4	111	104.3	38.0	171	160.7	58.5	231	217.1	79.0	291	273.5	99.5
52	48.9	17.8	12	105.2	38.3	72	161.6	58.8	32	218.0	79.3	92	274.4	99.9
53	49.8	18.1	13	106.2	38.6	73	162.6	59.2	33	218.9	79.7	93	275.3	100.2
54	50.7	18.5	14	107.1	39.0	74	163.5	59.5	34	219.9	80.0	94	276.3	100.6
55	51.7	18.8	15	108.1	39.3	75	164.4	59.9	35	220.8	80.4	95	277.2	100.9
56	52.6	19.2	16	109.0	39.7	76	165.4	60.2	36	221.8	80.7	96	278.1	101.2
57	53.6	19.5	17	109.9	40.0	77	166.3	60.5	37	222.7	81.1	97	279.1	101.6
58	54.5	19.8	18	110.9	40.4	78	167.3	60.9	38	223.6	81.4	98	280.0	101.9
59	55.4	20.2	19	111.8	40.7	79	168.2	61.2	39	224.6	81.7	99	281.0	102.3
60	56.4	20.5	20	112.8	41.0	80	169.1	61.6	40	225.5	82.1	300	281.9	102.6

Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

[For 70 Degrees.

DIFFERENCE OF LATITUDE AND DEPARTURE FOR 21°.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	0.9	0.4	61	56.9	21.9	121	113.0	43 4	181	169.0	64.9	241	225.0	86.4
2	1.9	0.7	62	57.9	22.2	22	113.9	43.7	82	169.9	65.2	42	225.9	86.7
3	2.8	1.1	63	58.8	22.6	23	114.8	44.1	83	170.8	65.6	43	226.9	87.1
4	3.7	1.4	64	59.7	22.9	24	115.8	44.4	84	171.8	65.9	44	227.8	87.4
5	4.7	1.8	65	60.7	23.3	25	116.7	44.8	85	172.7	66.3	45	228.7	87.8
6	5.6	2.2	66	61.6	23.7	26	117.6	45.2	86	173.6	66.7	46	229.7	88.2
7	6.5	2.5	67	62.5	24.0	27	118.6	45.5	87	174.6	67.0	47	230.6	88.5
8	7.5	2.9	68	63.5	24.4	28	119.5	45.9	88	175.5	67.4	48	231.5	88.9
9	8.4	3.2	69	64.4	24.7	29	120.4	46.2	89	176.4	67.7	49	232.5	89.2
10	9.3	3.6	70	65.4	25.1	30	121.4	46.6	90	177.4	68.1	50	233.4	89.6
11	10.3	3.9	71	66.3	25.4	131	122.3	46.9	191	178.3	68.4	251	234.3	90.0
12	11.2	4.3	72	67.2	25.8	32	123.2	47.3	92	179.2	68.8	52	235.3	90.3
13	12.1	4.7	73	68.2	26.2	33	124.2	47.7	93	180.2	69.2	53	236.2	90.7
14	13.1	5.0	74	69.1	26.5	34	125.1	48.0	94	181.1	69.5	54	237.1	91.0
15	14.0	5.4	75	70.0	26.9	35	126.0	48.4	95	182.0	69.9	55	238.1	91.4
16	14.9	5.7	76	71.0	27.2	36	127.0	48.7	96	183.0	70.2	56	239.0	91.7
17	15.9	6.1	77	71.9	27.6	37	127.9	49.1	97	183.9	70.6	57	239.9	92.1
18	16.8	6.5	78	72.8	28.0	38	128.8	49.5	98	184.8	71.0	58	240.9	92.5
19	17.7	6.8	79	73.8	28.3	39	129.8	49.8	99	185.8	71.3	59	241.8	92.8
20	18.7	7.2	80	74.7	28.7	40	130.7	50.2	200	186.7	71.7	60	242.7	93.2
21	19.6	7.5	81	75.6	29.0	141	131.6	50.5	201	187.6	72.0	261	243.7	93.5
22	20.5	7.9	82	76.6	29.4	42	132.6	50.9	02	188.6	72.4	62	244.6	93.9
23	21.5	8.2	83	77.5	29.7	43	133.5	51.2	03	189.5	72.7	63	245.5	94.3
24	22.4	8.6	84	78.4	30.1	44	134.4	51.6	04	190.5	73.1	64	246.5	94.6
25	23.3	9.0	85	79.4	30.5	45	135.4	52.0	05	191.4	73.5	65	247.4	95.0
26	24.3	9.3	86	80.3	30.8	46	136.3	52.3	06	192.3	73.8	66	248.3	95.3
27	25.2	9.7	87	81.2	31.2	47	137.2	52.7	07	193.3	74.2	67	249.3	95.7
28	26.1	10.0	88	82.2	31.5	48	138.2	53.0	08	194.2	74.5	68	250.2	96.0
29	27.1	10.4	89	83.1	31.9	49	139.1	53.4	09	195.1	74.9	69	251.1	96.4
30	28.0	10.8	90	84.0	32.3	50	140.0	53.8	10	196.1	75.3	70	252.1	96.8
31	28.9	11.1	91	85.0	32.6	151	141.0	54.1	211	197.0	75.6	271	253.0	97.1
32	29.9	11.5	92	85.9	33.0	52	141.9	54.5	12	197.9	76.0	72	253.9	97.5
33	30.8	11.8	93	86.8	33.3	53	142.8	54.8	13	198.9	76.3	73	254.9	97.8
34	31.7	12.2	94	87.8	33.7	54	143.8	55.2	14	199.8	76.7	74	255.8	98.2
35	32.7	12.5	95	88.7	34.0	55	144.7	55.5	15	200.7	77.0	75	256.7	98.6
36	33.6	12.9	96	89.6	34.4	56	145.6	55.9	16	201.7	77.4	76	257.7	98.9
37	34.5	13.3	97	90.6	34.8	57	146.6	56.3	17	202.6	77.8	77	258.6	99.3
38	35.5	13.6	98	91.5	35.1	58	147.5	56.6	18	203.5	78.1	78	259.5	99.6
39	36.4	14.0	99	92.4	35.5	59	148.4	57.0	19	204.5	78.5	79	260.5	100.0
40	37.3	14.3	100	93.4	35.8	60	149.4	57.3	20	205.4	78.8	80	261.4	100.3
41	38.3	14.7	101	94.3	36.2	161	150.3	57.7	221	206.3	79.2	281	262.3	100.7
42	39.2	15.1	02	95.2	36.6	62	151.2	58.1	22	207.3	79.6	82	263.3	101.1
43	40.1	15.4	03	96.2	36.9	63	152.2	58.4	23	208.2	79.9	83	264.2	101.4
44	41.1	15.8	04	97.1	37.3	64	153.1	58.8	24	209.1	80.3	84	265.1	101.8
45	42.0	16.1	05	98.0	37.6	65	154.0	59.1	25	210.1	80.6	85	266.1	102.1
46	42.9	16.5	06	99.0	38.0	66	155.0	59.5	26	211.0	81.0	86	267.0	102.5
47	43.9	16.8	07	99.9	38.3	67	155.9	59.8	27	211.9	81.3	87	267.9	102.9
48	44.8	17.2	08	100.8	38.7	68	156.8	60.2	28	212.9	81.7	88	268.9	103.2
49	45.7	17.6	09	101.8	39.1	69	157.8	60.6	29	213.8	82.1	89	269.8	103.6
50	46.7	17.9	10	102.7	39.4	70	158.7	60.9	30	214.7	82.4	90	270.7	103.9
51	47.6	18.3	11	103.6	39.8	171	159.6	61.3	231	215.7	82.8	291	271.7	104.3
52	48.5	18.6	12	104.6	40.1	72	160.6	61.6	32	216.6	83.1	92	272.6	104.6
53	49.5	19.0	13	105.5	40.5	73	161.5	62.0	33	217.5	83.5	93	273.5	105.0
54	50.4	19.4	14	106.4	40.9	74	162.4	62.4	34	218.5	83.9	94	274.5	105.4
55	51.3	19.7	15	107.4	41.2	75	163.4	62.7	35	219.4	84.2	95	275.4	105.7
56	52.3	20.1	16	108.3	41.6	76	164.3	63.1	36	220.3	84.6	96	276.3	106.1
57	53.2	20.4	17	109.2	41.9	77	165.2	63.4	37	221.3	84.9	97	277.3	106.4
58	54.1	20.8	18	110.2	42.3	78	166.2	63.8	38	222.2	85.3	98	278.2	106.8
59	55.1	21.1	19	111.1	42.6	79	167.1	64.1	39	223.1	85.6	99	279.1	107.2
60	56.0	21.5	20	112.0	43.0	80	168.0	64.5	40	224.1	86.0	300	280.1	107.5

Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

[For 69 Degrees.

DIFFERENCE OF LATITUDE AND DEPARTURE FOR 22°.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	0.9	0.4	61	56.6	22.9	121	112.2	45.3	181	167.8	67.8	241	223.5	90.3
2	1.9	0.7	62	57.5	23.2	22	113.1	45.7	82	168.7	68.2	42	224.4	90.7
3	2.8	1.1	63	58.4	23.6	23	114.0	46.1	83	169.7	68.6	43	225.3	91.0
4	3.7	1.5	64	59.3	24.0	24	115.0	46.5	84	170.6	68.9	44	226.2	91.4
5	4.6	1.9	65	60.3	24.3	25	115.9	46.8	85	171.5	69.3	45	227.2	91.8
6	5.6	2.2	66	61.2	24.7	26	116.8	47.2	86	172.5	69.7	46	228.1	92.2
7	6.5	2.6	67	62.1	25.1	27	117.8	47.6	87	173.4	70.1	47	229.0	92.5
8	7.4	3.0	68	63.0	25.5	28	118.7	47.9	88	174.3	70.4	48	229.9	92.9
9	8.3	3.4	69	64.0	25.8	29	119.6	48.3	89	175.2	70.8	49	230.9	93.3
10	9.3	3.7	70	64.9	26.2	30	120.5	48.7	90	176.2	71.2	50	231.8	93.7
11	10.2	4.1	71	65.8	26.6	131	121.5	49.1	191	177.1	71.5	251	232.7	94.0
12	11.1	4.5	72	66.8	27.0	32	122.4	49.4	92	178.0	71.9	52	233.7	94.4
13	12.1	4.9	73	67.7	27.3	33	123.3	49.8	93	178.9	72.3	53	234.6	94.8
14	13.0	5.2	74	68.6	27.7	34	124.2	50.2	94	179.9	72.7	54	235.5	95.2
15	13.9	5.6	75	69.5	28.1	35	125.2	50.6	95	180.8	73.0	55	236.4	95.5
16	14.8	6.0	76	70.5	28.5	36	126.1	50.9	96	181.7	73.4	56	237.4	95.9
17	15.8	6.4	77	71.4	28.8	37	127.0	51.3	97	182.7	73.8	57	238.3	96.3
18	16.7	6.7	78	72.3	29.2	38	128.0	51.7	98	183.6	74.2	58	239.2	96.6
19	17.6	7.1	79	73.2	29.6	39	128.9	52.1	99	184.5	74.5	59	240.1	97.0
20	18.5	7.5	80	74.2	30.0	40	129.8	52.4	200	185.4	74.9	60	241.1	97.4
21	19.5	7.9	81	75.1	30.3	141	130.7	52.8	201	186.4	75.3	261	242.0	97.8
22	20.4	8.2	82	76.0	30.7	42	131.7	53.2	02	187.3	75.7	62	242.9	98.1
23	21.3	8.6	83	77.0	31.1	43	132.6	53.6	03	188.2	76.0	63	243.8	98.5
24	22.3	9.0	84	77.9	31.5	44	133.5	53.9	04	189.1	76.4	64	244.8	98.9
25	23.2	9.4	85	78.8	31.8	45	134.4	54.3	05	190.1	76.8	65	245.7	99.3
26	24.1	9.7	86	79.7	32.2	46	135.4	54.7	06	191.0	77.2	66	246.6	99.6
27	25.0	10.1	87	80.7	32.6	47	136.3	55.1	07	191.9	77.5	67	247.6	100.0
28	26.0	10.5	88	81.6	33.0	48	137.2	55.4	08	192.9	77.9	68	248.5	100.4
29	26.9	10.9	89	82.5	33.3	49	138.2	55.8	09	193.8	78.3	69	249.4	100.8
30	27.8	11.2	90	83.4	33.7	50	139.1	56.2	10	194.7	78.7	70	250.3	101.1
31	28.7	11.6	91	84.4	34.1	151	140.0	56.6	211	195.6	79.0	271	251.3	101.5
32	29.7	12.0	92	85.3	34.5	52	140.9	56.9	12	196.6	79.4	72	252.2	101.9
33	30.6	12.4	93	86.2	34.8	53	141.9	57.3	13	197.5	79.8	73	253.1	102.3
34	31.5	12.7	94	87.2	35.2	54	142.8	57.7	14	198.4	80.2	74	254.0	102.6
35	32.5	13.1	95	88.1	35.6	55	143.7	58.1	15	199.3	80.5	75	255.0	103.0
36	33.4	13.5	96	89.0	36.0	56	144.6	58.4	16	200.3	80.9	76	255.9	103.4
37	34.3	13.9	97	89.9	36.3	57	145.6	58.8	17	201.2	81.3	77	256.8	103.8
38	35.2	14.2	98	90.9	36.7	58	146.5	59.2	18	202.1	81.7	78	257.8	104.1
39	36.2	14.6	99	91.8	37.1	59	147.4	59.6	19	203.1	82.0	79	258.7	104.5
40	37.1	15.0	100	92.7	37.5	60	148.3	59.9	20	204.0	82.4	80	259.6	104.9
41	38.0	15.4	101	93.6	37.8	161	149.3	60.3	221	204.9	82.8	281	260.5	105.3
42	38.9	15.7	02	94.6	38.2	62	150.2	60.7	22	205.8	83.2	82	261.5	105.6
43	39.9	16.1	03	95.5	38.6	63	151.1	61.1	23	206.8	83.5	83	262.4	106.0
44	40.8	16.5	04	96.4	39.0	64	152.1	61.4	24	207.7	83.9	84	263.3	106.4
45	41.7	16.9	05	97.4	39.3	65	153.0	61.8	25	208.6	84.3	85	264.2	106.8
46	42.7	17.2	06	98.3	39.7	66	153.9	62.2	26	209.5	84.7	86	265.2	107.1
47	43.6	17.6	07	99.2	40.1	67	154.8	62.6	27	210.5	85.0	87	266.1	107.5
48	44.5	18.0	08	100.1	40.5	68	155.8	62.9	28	211.4	85.4	88	267.0	107.9
49	45.4	18.4	09	101.1	40.8	69	156.7	63.3	29	212.3	85.8	89	268.0	108.3
50	46.4	18.7	10	102.0	41.2	70	157.6	63.7	30	213.3	86.2	90	268.9	108.6
51	47.3	19.1	111	102.9	41.6	171	158.5	64.1	231	214.2	86.5	291	269.8	109.0
52	48.2	19.5	12	103.8	42.0	72	159.5	64.4	32	215.1	86.9	92	270.7	109.4
53	49.1	19.9	13	104.8	42.3	73	160.4	64.8	33	216.0	87.3	93	271.7	109.8
54	50.1	20.2	14	105.7	42.7	74	161.3	65.2	34	217.0	87.7	94	272.6	110.1
55	51.0	20.6	15	106.6	43.1	75	162.3	65.6	35	217.9	88.0	95	273.5	110.5
56	51.9	21.0	16	107.6	43.5	76	163.2	65.9	36	218.8	88.4	96	274.4	110.9
57	52.8	21.4	17	108.5	43.8	77	164.1	66.3	37	219.7	88.8	97	275.4	111.3
58	53.8	21.7	18	109.4	44.2	78	165.0	66.7	38	220.7	89.2	98	276.3	111.6
59	54.7	22.1	19	110.3	44.6	79	166.0	67.1	39	221.6	89.5	99	277.2	112.0
60	55.6	22.5	20	111.3	45.0	80	166.9	67.4	40	222.5	89.9	300	278.2	112.4

Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

[For 68 Degrees.

DIFFERENCE OF LATITUDE AND DEPARTURE FOR 23°.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	0.9	0.4	61	56.2	23.8	121	111.4	47.3	181	166.6	70.7	241	221.8	94.2
2	1.8	0.8	62	57.1	24.2	122	112.3	47.7	82	167.5	71.1	42	222.8	94.6
3	2.8	1.2	63	58.0	24.6	23	113.2	48.1	83	168.5	71.5	43	223.7	94.9
4	3.7	1.6	64	58.9	25.0	24	114.1	48.5	84	169.4	71.9	44	224.6	95.3
5	4.6	2.0	65	59.8	25.4	25	115.1	48.8	85	170.3	72.3	45	225.5	95.7
6	5.5	2.3	66	60.8	25.8	26	116.0	49.2	86	171.2	72.7	46	226.4	96.1
7	6.4	2.7	67	61.7	26.2	27	116.9	49.6	87	172.1	73.1	47	227.4	96.5
8	7.4	3.1	68	62.6	26.6	28	117.8	50.0	88	173.1	73.5	48	228.3	96.9
9	8.3	3.5	69	63.5	27.0	29	118.7	50.4	89	174.0	73.8	49	229.2	97.3
10	9.2	3.9	70	64.4	27.4	30	119.7	50.8	90	174.9	74.2	50	230.1	97.7
11	10.1	4.3	71	65.4	27.7	131	120.6	51.2	191	175.8	74.6	251	231.0	98.1
12	11.0	4.7	72	66.3	28.1	32	121.5	51.6	92	176.7	75.0	52	232.0	98.5
13	12.0	5.1	73	67.2	28.5	33	122.4	52.0	93	177.7	75.4	53	232.9	98.9
14	12.9	5.5	74	68.1	28.9	34	123.3	52.4	94	178.6	75.8	54	233.8	99.2
15	13.8	5.9	75	69.0	29.3	35	124.2	52.7	95	179.5	76.2	55	234.7	99.6
16	14.7	6.3	76	70.0	29.7	36	125.2	53.1	96	180.4	76.6	56	235.6	100.0
17	15.6	6.6	77	70.9	30.1	37	126.1	53.5	97	181.3	77.0	57	236.6	100.4
18	16.6	7.0	78	71.8	30.5	38	127.0	53.9	98	182.3	77.4	58	237.5	100.8
19	17.5	7.4	79	72.7	30.9	39	128.0	54.3	99	183.2	77.8	59	238.4	101.2
20	18.4	7.8	80	73.6	31.3	40	128.9	54.7	200	184.1	78.1	60	239.3	101.6
21	19.3	8.2	81	74.6	31.6	141	129.8	55.1	201	185.0	78.5	261	240.3	102.0
22	20.3	8.6	82	75.5	32.0	42	130.7	55.5	02	186.0	78.9	62	241.2	102.4
23	21.2	9.0	83	76.4	32.4	43	131.6	55.9	03	186.9	79.3	63	242.1	102.8
24	22.1	9.4	84	77.3	32.8	44	132.6	56.3	04	187.8	79.7	64	243.0	103.2
25	23.0	9.8	85	78.2	33.2	45	133.5	56.7	05	188.7	80.1	65	243.9	103.5
26	23.9	10.2	86	79.2	33.6	46	134.4	57.0	06	189.6	80.5	66	244.9	103.9
27	24.9	10.5	87	80.1	34.0	47	135.3	57.4	07	190.5	80.9	67	245.8	104.3
28	25.8	10.9	88	81.0	34.4	48	136.2	57.8	08	191.5	81.3	68	246.7	104.7
29	26.7	11.3	89	81.9	34.8	49	137.2	58.2	09	192.4	81.7	69	247.6	105.1
30	27.6	11.7	90	82.8	35.2	50	138.1	58.6	10	193.3	82.1	70	248.5	105.5
31	28.5	12.1	91	83.8	35.6	151	139.0	59.0	211	194.2	82.4	271	249.5	105.9
32	29.5	12.5	92	84.7	35.9	52	139.9	59.4	12	195.1	82.8	72	250.4	106.3
33	30.4	12.9	93	85.6	36.3	53	140.8	59.8	13	196.1	83.2	73	251.3	106.7
34	31.3	13.3	94	86.5	36.7	54	141.8	60.2	14	197.0	83.6	74	252.2	107.1
35	32.2	13.7	95	87.4	37.1	55	142.7	60.6	15	197.9	84.0	75	253.1	107.5
36	33.1	14.1	96	88.4	37.5	56	143.6	61.0	16	198.8	84.4	76	254.1	107.8
37	34.1	14.5	97	89.3	37.9	57	144.5	61.3	17	199.7	84.8	77	255.0	108.2
38	35.0	14.8	98	90.2	38.3	58	145.4	61.7	18	200.7	85.2	78	255.9	108.6
39	35.9	15.2	99	91.1	38.7	59	146.4	62.1	19	201.6	85.6	79	256.8	109.0
40	36.8	15.6	100	92.1	39.1	60	147.3	62.5	20	202.5	86.0	80	257.7	109.4
41	37.7	16.0	101	93.0	39.5	161	148.2	62.9	221	203.4	86.4	281	258.7	109.8
42	38.7	16.4	02	93.9	39.9	62	149.1	63.3	22	204.4	86.7	82	259.6	110.2
43	39.6	16.8	03	94.8	40.2	63	150.0	63.7	23	205.3	87.1	83	260.5	110.6
44	40.5	17.2	04	95.7	40.6	64	151.0	64.1	24	206.2	87.5	84	261.4	111.0
45	41.4	17.6	05	96.7	41.0	65	151.9	64.5	25	207.1	87.9	85	262.3	111.4
46	42.3	18.0	06	97.6	41.4	66	152.8	64.9	26	208.0	88.3	86	263.3	111.7
47	43.3	18.4	07	98.5	41.8	67	153.7	65.3	27	209.0	88.7	87	264.2	112.1
48	44.2	18.8	08	99.4	42.2	68	154.6	65.6	28	209.9	89.1	88	265.1	112.5
49	45.1	19.1	09	100.3	42.6	69	155.6	66.0	29	210.8	89.5	89	266.0	112.9
50	46.0	19.5	10	101.3	43.0	70	156.5	66.4	30	211.7	89.9	90	266.9	113.3
51	46.9	19.9	111	102.2	43.4	171	157.4	66.8	231	212.6	90.3	291	267.9	113.7
52	47.9	20.3	12	103.1	43.8	72	158.3	67.2	32	213.6	90.6	92	268.8	114.1
53	48.8	20.7	13	104.0	44.2	73	159.2	67.6	33	214.5	91.0	93	269.7	114.5
54	49.7	21.1	14	104.9	44.5	74	160.2	68.0	34	215.4	91.4	94	270.6	114.9
55	50.6	21.5	15	105.9	44.9	75	161.1	68.4	35	216.3	91.8	95	271.5	115.3
56	51.5	21.9	16	106.8	45.3	76	162.0	68.8	36	217.2	92.2	96	272.5	115.7
57	52.5	22.3	17	107.7	45.7	77	162.9	69.2	37	218.2	92.6	97	273.4	116.0
58	53.4	22.7	18	108.6	46.1	78	163.8	69.6	38	219.1	93.0	98	274.3	116.4
59	54.3	23.1	19	109.5	46.5	79	164.8	69.9	39	220.0	93.4	99	275.2	116.8
60	55.2	23.4	80	110.5	46.9	80	165.7	70.3	40	820.9	93.8	300	276.2	117.2

Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

[For 67 Degrees.

DIFFERENCE OF LATITUDE AND DEPARTURE FOR 21°.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep
1	0.9	0.4	61	55.7	24.8	121	110.5	49.2	181	165.4	73.6	241	220.2	98.0
2	1.8	0.8	62	56.6	25.2	122	111.5	49.6	182	166.3	74.0	242	221.1	98.4
3	2.7	1.2	63	57.6	25.6	123	112.4	50.0	183	167.2	74.4	43	222.0	98.8
4	3.7	1.6	64	58.5	26.0	24	113.3	50.4	84	168.1	74.8	44	222.9	99.2
5	4.6	2.0	65	59.4	26.4	25	114.2	50.8	85	169.0	75.2	45	223.8	99.7
6	5.5	2.4	66	60.3	26.8	26	115.1	51.2	86	169.9	75.7	46	224.7	100.1
7	6.4	2.8	67	61.2	27.3	27	116.0	51.7	87	170.8	76.1	47	225.6	100.5
8	7.3	3.3	68	62.1	27.7	28	116.9	52.1	88	171.7	76.5	48	226.6	100.9
9	8.2	3.7	69	63.0	28.1	29	117.8	52.5	89	172.7	76.9	49	227.5	101.3
10	9.1	4.1	70	63.9	28.5	30	118.8	52.9	90	173.6	77.3	50	228.4	101.7
11	10.0	4.5	71	64.9	28.9	131	119.7	53.3	191	174.5	77.7	251	229.3	102.1
12	11.0	4.9	72	65.8	29.3	32	120.6	53.7	92	175.4	78.1	52	230.2	102.5
13	11.9	5.3	73	66.7	29.7	33	121.5	54.1	93	176.3	78.5	53	231.1	102.9
14	12.8	5.7	74	67.6	30.1	34	122.4	54.5	94	177.2	78.9	54	232.0	103.3
15	13.7	6.1	75	68.5	30.5	35	123.3	54.9	95	178.1	79.3	55	233.0	103.7
16	14.6	6.5	76	69.4	30.9	36	124.2	55.3	96	179.1	79.7	56	233.9	104.1
17	15.5	6.9	77	70.3	31.3	37	125.2	55.7	97	180.0	80.1	57	234.8	104.5
18	16.4	7.3	78	71.3	31.7	38	126.1	56.1	98	180.9	80.5	58	235.7	104.9
19	17.4	7.7	79	72.2	32.1	39	127.0	56.5	99	181.8	80.9	59	236.6	105.3
20	18.3	8.1	80	73.1	32.5	40	127.9	56.9	200	182.7	81.3	60	237.5	105.8
21	19.2	8.5	81	74.0	32.9	141	128.8	57.3	201	183.6	81.8	261	238.4	106.2
22	20.1	8.9	82	74.9	33.4	42	129.7	57.8	02	184.5	82.2	62	239.3	106.6
23	21.0	9.4	83	75.8	33.8	43	130.6	58.2	03	185.4	82.6	63	240.3	107.0
24	21.9	9.8	84	76.7	34.2	44	131.6	58.6	04	186.4	83.0	64	241.2	107.4
25	22.8	10.2	85	77.7	34.6	45	132.5	59.0	05	187.3	83.4	65	242.1	107.8
26	23.8	10.6	86	78.6	35.0	46	133.4	59.4	06	188.2	83.8	66	243.0	108.2
27	24.7	11.0	87	79.5	35.4	47	134.3	59.8	07	189.1	84.2	67	243.9	108.6
28	25.6	11.4	88	80.4	35.8	48	135.2	60.2	08	190.0	84.6	68	244.8	109.0
29	26.5	11.8	89	81.3	36.2	49	136.1	60.6	09	190.9	85.0	69	245.7	109.4
30	27.4	12.2	90	82.2	36.6	50	137.0	61.0	10	191.8	85.4	70	246.7	109.8
31	28.3	12.6	91	83.1	37.0	151	137.9	61.4	211	192.8	85.8	271	247.6	110.2
32	29.2	13.0	92	84.0	37.4	52	138.9	61.8	12	193.7	86.2	72	248.5	110.6
33	30.1	13.4	93	85.0	37.8	53	139.8	62.2	13	194.6	86.6	73	249.4	111.0
34	31.1	13.8	94	85.9	38.2	54	140.7	62.6	14	195.5	87.0	74	250.3	111.4
35	32.0	14.2	95	86.8	38.6	55	141.6	63.0	15	196.4	87.4	75	251.2	111.9
36	32.9	14.6	96	87.7	39.0	56	142.5	63.5	16	197.3	87.9	76	252.1	112.3
37	33.8	15.0	97	88.6	39.5	57	143.4	63.9	17	198.2	88.3	77	253.1	112.7
38	34.7	15.5	98	89.5	39.9	58	144.3	64.3	18	199.2	88.7	78	254.0	113.1
39	35.6	15.9	99	90.4	40.3	59	145.3	64.7	19	200.1	89.1	79	254.9	113.5
40	36.5	16.3	100	91.4	40.7	60	146.2	65.1	20	201.0	89.5	80	255.8	113.9
41	37.5	16.7	101	92.3	41.1	161	147.1	65.5	221	201.9	89.9	281	256.7	114.3
42	38.4	17.1	02	93.2	41.5	62	148.0	65.9	22	202.8	90.3	82	257.6	114.7
43	39.3	17.5	03	94.1	41.9	63	148.9	66.3	23	203.7	90.7	83	258.5	115.1
44	40.2	17.9	04	95.0	42.3	64	149.8	66.7	24	204.6	91.1	84	259.4	115.5
45	41.1	18.3	05	95.9	42.7	65	150.7	67.1	25	205.5	91.5	85	260.4	115.9
46	42.0	18.7	06	96.8	43.1	66	151.6	67.5	26	206.5	91.9	86	261.3	116.3
47	42.9	19.1	07	97.7	43.5	67	152.6	67.9	27	207.4	92.3	87	262.2	116.7
48	43.9	19.5	08	98.7	43.9	68	153.5	68.3	28	208.3	92.7	88	263.1	117.1
49	44.8	19.9	09	99.6	44.3	69	154.4	68.7	29	209.2	93.1	89	264.0	117.5
50	45.7	20.3	10	100.5	44.7	70	155.3	69.1	30	210.1	93.5	90	264.9	118.0
51	46.6	20.7	111	101.4	45.1	171	156.2	69.6	231	211.0	94.0	291	265.8	118.4
52	47.5	21.2	12	102.3	45.6	72	157.1	70.0	32	211.9	94.4	92	266.8	118.8
53	48.4	21.6	13	103.2	46.0	73	158.0	70.4	33	212.9	94.8	93	267.7	119.2
54	49.3	22.0	14	104.1	46.4	74	159.0	70.8	34	213.8	95.2	94	268.6	119.6
55	50.2	22.4	15	105.1	46.8	75	159.9	71.2	35	214.7	95.6	95	269.5	120.0
56	51.2	22.8	16	106.0	47.2	76	160.8	71.6	36	215.6	96.0	96	270.4	120.4
57	52.1	23.2	17	106.9	47.6	77	161.7	72.0	37	216.5	96.4	97	271.3	120.8
58	53.0	23.6	18	107.8	48.0	78	162.6	72.4	38	217.4	96.8	98	272.2	121.2
59	53.9	24.0	19	108.7	48.4	79	163.5	72.8	39	218.3	97.2	99	273.2	121.6
60	54.8	24.4	20	109.6	48.8	80	164.4	73.2	40	219.3	97.6	300	274.1	122.0

Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

[For 66 Degrees.

DIFFERENCE OF LATITUDE AND DEPARTURE FOR 25°.

Dist	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	0.9	0.4	61	55.3	25.8	121	109.7	51.1	181	164.0	76.5	241	218.4	101.9
2	1.8	0.8	62	56.2	26.2	122	110.6	51.6	182	164.9	76.9	242	219.3	102.3
3	2.7	1.3	63	57.1	26.6	123	111.5	52.0	183	165.9	77.3	243	220.2	102.7
4	3.6	1.7	64	58.0	27.0	124	112.4	52.4	184	166.8	77.8	244	221.1	103.1
5	4.5	2.1	65	58.9	27.5	125	113.3	52.8	185	167.7	78.2	245	222.0	103.5
6	5.4	2.5	66	59.8	27.9	126	114.2	53.2	186	168.6	78.6	246	223.0	104.0
7	6.3	3.0	67	60.7	28.3	127	115.1	53.7	187	169.5	79.0	247	223.9	104.4
8	7.3	3.4	68	61.6	28.7	128	116.0	54.1	188	170.4	79.5	248	224.8	104.8
9	8.2	3.8	69	62.5	29.2	129	116.9	54.5	189	171.3	79.9	249	225.7	105.2
10	9.1	4.2	70	63.4	29.6	130	117.8	54.9	190	172.2	80.3	250	226.6	105.7
11	10.0	4.6	71	64.3	30.0	131	118.7	55.4	191	173.1	80.7	251	227.5	106.1
12	10.9	5.1	72	65.3	30.4	132	119.6	55.8	192	174.0	81.1	252	228.4	106.5
13	11.8	5.5	73	66.2	30.9	133	120.5	56.2	193	174.9	81.6	253	229.3	106.9
14	12.7	5.9	74	67.1	31.3	134	121.4	56.6	194	175.8	82.0	254	230.2	107.3
15	13.6	6.3	75	68.0	31.7	135	122.4	57.1	195	176.7	82.4	255	231.1	107.8
16	14.5	6.8	76	68.9	32.1	136	123.3	57.5	196	177.6	82.8	256	232.0	108.2
17	15.4	7.2	77	69.8	32.5	137	124.2	57.9	197	178.5	83.3	257	232.9	108.6
18	16.3	7.6	78	70.7	33.0	138	125.1	58.3	198	179.4	83.7	258	233.8	109.0
19	17.2	8.0	79	71.6	33.4	139	126.0	58.7	199	180.4	84.1	259	234.7	109.5
20	18.1	8.5	80	72.5	33.8	140	126.9	59.2	200	181.3	84.5	260	235.6	109.9
21	19.0	8.9	81	73.4	34.2	141	127.8	59.6	201	182.2	84.9	261	236.5	110.3
22	19.9	9.3	82	74.3	34.7	142	128.7	60.0	02	183.1	85.4	62	237.5	110.7
23	20.8	9.7	83	75.2	35.1	43	129.6	60.4	03	184.0	85.8	63	238.4	111.1
24	21.8	10.1	84	76.1	35.5	44	130.5	60.9	04	184.9	86.2	64	239.3	111.6
25	22.7	10.6	85	77.0	35.9	45	131.4	61.3	05	185.8	86.6	65	240.2	112.0
26	23.6	11.0	86	77.9	36.3	46	132.3	61.7	06	186.7	87.1	66	241.1	112.4
27	24.5	11.4	87	78.8	36.8	47	133.2	62.1	07	187.6	87.5	67	242.0	112.8
28	25.4	11.8	88	79.8	37.2	48	134.1	62.5	08	188.5	87.9	68	242.9	113.3
29	26.3	12.3	89	80.7	37.6	49	135.0	63.0	09	189.4	88.3	69	243.8	113.7
30	27.2	12.7	90	81.6	38.0	50	135.9	63.4	10	190.3	88.7	70	244.7	114.1
31	28.1	13.1	91	82.5	38.5	151	136.9	63.8	211	191.2	89.2	271	245.6	114.5
32	29.0	13.5	92	83.4	38.9	52	137.8	64.2	12	192.1	89.6	72	246.5	115.0
33	29.9	13.9	93	84.3	39.3	53	138.7	64.7	13	193.0	90.0	73	247.4	115.4
34	30.8	14.4	94	85.2	39.7	54	139.6	65.1	14	193.9	90.4	74	248.3	115.8
35	31.7	14.8	95	86.1	40.1	55	140.5	65.5	15	194.9	90.9	75	249.2	116.2
36	32.6	15.2	96	87.0	40.6	56	141.4	65.9	16	195.8	91.3	76	250.1	116.6
37	33.5	15.6	97	87.9	41.0	57	142.3	66.4	17	196.7	91.7	77	251.0	117.1
38	34.4	16.1	98	88.8	41.4	58	143.2	66.8	18	197.6	92.1	78	252.0	117.5
39	35.3	16.5	99	89.7	41.8	59	144.1	67.2	19	198.5	92.6	79	252.9	117.9
40	36.3	16.9	100	90.6	42.3	60	145.0	67.6	20	199.4	93.0	80	253.8	118.3
41	37.2	17.3	101	91.5	42.7	161	145.9	68.0	221	200.3	93.4	281	254.7	118.8
42	38.1	17.7	02	92.4	43.1	62	146.8	68.5	22	201.2	93.8	82	255.6	119.2
43	39.0	18.2	03	93.3	43.5	63	147.7	68.9	23	202.1	94.2	83	256.5	119.6
44	39.9	18.6	04	94.3	44.0	64	148.6	69.3	24	203.0	94.7	84	257.4	120.0
45	40.8	19.0	05	95.2	44.4	65	149.5	69.7	25	203.9	95.1	85	258.3	120.4
46	41.7	19.4	06	96.1	44.8	66	150.4	70.2	26	204.8	95.5	86	259.2	120.9
47	42.6	19.9	07	97.0	45.2	67	151.4	70.6	27	205.7	95.9	87	260.1	121.3
48	43.5	20.3	08	97.9	45.6	68	152.3	71.0	28	206.6	96.4	88	261.0	121.7
49	44.4	20.7	09	98.8	46.1	69	153.2	71.4	29	207.5	96.8	89	261.9	122.1
50	45.3	21.1	10	99.7	46.5	70	154.1	71.8	30	208.5	97.2	90	262.8	122.6
51	46.2	21.6	111	100.6	46.9	171	155.0	72.3	231	209.4	97.6	291	263.7	123.0
52	47.1	22.0	12	101.5	47.3	72	155.9	72.7	32	210.3	98.0	92	264.6	123.4
53	48.0	22.4	13	102.4	47.8	73	156.8	73.1	33	211.2	98.5	93	265.5	123.8
54	48.9	22.8	14	103.3	48.2	74	157.7	73.5	34	212.1	98.9	94	266.5	124.2
55	49.8	23.2	15	104.2	48.6	75	158.6	74.0	35	213.0	99.3	95	267.4	124.7
56	50.8	23.7	16	105.1	49.0	76	159.5	74.4	36	213.9	99.7	96	268.3	125.1
57	51.7	24.1	17	106.0	49.4	77	160.4	74.8	37	214.8	100.2	97	269.2	125.5
58	52.6	24.5	18	106.9	49.9	78	161.3	75.2	38	215.7	100.6	98	270.1	125.9
59	53.5	24.9	19	107.9	50.3	79	162.2	75.6	39	216.6	101.0	99	271.0	126.4
60	54.4	25.4	20	108.8	50.7	80	163.1	76.1	40	217.5	101.4	300	271.9	126.8

Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

[For 65 Degrees.

DIFFERENCE OF LATITUDE AND DEPARTURE FOR 28°.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	0.9	0.4	61	54.8	26.7	121	108.8	53.0	181	162.7	79.3	241	216.6	105.6
2	1.8	0.9	62	55.7	27.2	22	109.7	53.5	82	163.6	79.8	42	217.5	106.1
3	2.7	1.3	63	56.6	27.6	23	110.6	53.9	83	164.5	80.2	43	218.4	106.5
4	3.6	1.8	64	57.5	28.1	24	111.5	54.4	84	165.4	80.7	44	219.3	107.0
5	4.5	2.2	65	58.4	28.5	25	112.3	54.8	85	166.3	81.1	45	220.2	107.4
6	5.4	2.6	66	59.3	28.9	26	113.2	55.2	86	167.2	81.5	46	221.1	107.8
7	6.3	3.1	67	60.2	29.4	27	114.1	55.7	87	168.1	82.0	47	222.0	108.3
8	7.2	3.5	68	61.1	29.8	28	115.0	56.1	88	169.0	82.4	48	222.9	108.7
9	8.1	3.9	69	62.0	30.2	29	115.9	56.5	89	169.9	82.9	49	223.8	109.2
10	9.0	4.4	70	62.9	30.7	30	116.8	57.0	90	170.8	83.3	50	224.7	109.6
11	9.9	4.8	71	63.8	31.1	131	117.7	57.4	191	171.7	83.7	251	225.6	110.0
12	10.8	5.3	72	64.7	31.6	32	118.6	57.9	92	172.6	84.2	52	226.5	110.5
13	11.7	5.7	73	65.6	32.0	33	119.5	58.3	93	173.5	84.6	53	227.4	110.9
14	12.6	6.1	74	66.5	32.4	34	120.4	58.7	94	174.4	85.0	54	228.3	111.3
15	13.5	6.6	75	67.4	32.9	35	121.3	59.2	95	175.3	85.5	55	229.2	111.8
16	14.4	7.0	76	68.3	33.3	36	122.2	59.6	96	176.2	85.9	56	230.1	112.2
17	15.3	7.5	77	69.2	33.8	37	123.1	60.1	97	177.1	86.4	57	231.0	112.7
18	16.2	7.9	78	70.1	34.2	38	124.0	60.5	98	178.0	86.8	58	231.9	113.1
19	17.1	8.3	79	71.0	34.6	39	124.9	60.9	99	178.9	87.2	59	232.8	113.5
20	18.0	8.8	80	71.9	35.1	40	125.8	61.4	200	179.8	87.7	60	233.7	114.0
21	18.9	9.2	81	72.8	35.5	141	126.7	61.8	201	180.7	88.1	261	234.6	114.4
22	19.8	9.6	82	73.7	35.9	42	127.6	62.2	02	181.6	88.6	62	235.5	114.9
23	20.7	10.1	83	74.6	36.4	43	128.5	62.7	03	182.5	89.0	63	236.4	115.3
24	21.6	10.5	84	75.5	36.8	44	129.4	63.1	04	183.4	89.4	64	237.3	115.7
25	22.5	11.0	85	76.4	37.3	45	130.3	63.6	05	184.3	89.9	65	238.2	116.2
26	23.4	11.4	86	77.3	37.7	46	131.2	64.0	06	185.2	90.3	66	239.1	116.6
27	24.3	11.8	87	78.2	38.1	47	132.1	64.4	07	186.1	90.7	67	240.0	117.0
28	25.2	12.3	88	79.1	38.6	48	133.0	64.9	08	186.9	91.2	68	240.9	117.5
29	26.1	12.7	89	80.0	39.0	49	133.9	65.3	09	187.8	91.6	69	241.8	117.9
30	27.0	13.2	90	80.9	39.5	50	134.8	65.8	10	188.7	92.1	70	242.7	118.4
31	27.9	13.6	91	81.8	39.9	151	135.7	66.2	211	189.6	92.5	271	243.6	118.8
32	28.8	14.0	92	82.7	40.3	52	136.6	66.6	12	190.5	92.9	72	244.5	119.2
33	29.7	14.5	93	83.6	40.8	53	137.5	67.1	13	191.4	93.4	73	245.4	119.7
34	30.6	14.9	94	84.5	41.2	54	138.4	67.5	14	192.3	93.8	74	246.3	120.1
35	31.5	15.3	95	85.4	41.6	55	139.3	67.9	15	193.2	94.2	75	247.2	120.6
36	32.4	15.8	96	86.3	42.1	56	140.2	68.4	16	194.1	94.7	76	248.1	121.0
37	33.3	16.2	97	87.2	42.5	57	141.1	68.8	17	195.0	95.1	77	249.0	121.4
38	34.2	16.7	98	88.1	43.0	58	142.0	69.3	18	195.9	95.6	78	249.9	121.9
39	35.1	17.1	99	89.0	43.4	59	142.9	69.7	19	196.8	96.0	79	250.8	122.3
40	36.0	17.5	100	89.9	43.8	60	143.8	70.1	20	197.7	96.4	80	251.7	122.7
41	36.9	18.0	101	90.8	44.3	161	144.7	70.6	221	198.6	96.9	281	252.6	123.2
42	37.7	18.4	02	91.7	44.7	62	145.6	71.0	22	199.5	97.3	82	253.5	123.6
43	38.6	18.8	03	92.6	45.2	63	146.5	71.5	23	200.4	97.8	83	254.4	124.1
44	39.5	19.3	04	93.5	45.6	64	147.4	71.9	24	201.3	98.2	84	255.3	124.5
45	40.4	19.7	05	94.4	46.0	65	148.3	72.3	25	202.2	98.6	85	256.2	124.9
46	41.3	20.2	06	95.3	46.5	66	149.2	72.8	26	203.1	99.1	86	257.1	125.4
47	42.2	20.6	07	96.2	46.9	67	150.1	73.2	27	204.0	99.5	87	258.0	125.8
48	43.1	21.0	08	97.1	47.3	68	151.0	73.6	28	204.9	99.9	88	258.9	126.3
49	44.0	21.5	09	98.0	47.8	69	151.9	74.1	29	205.8	100.4	89	259.8	126.7
50	44.9	21.9	10	98.9	48.2	70	152.8	74.5	30	206.7	100.8	90	260.7	127.1
51	45.8	22.4	111	99.8	48.7	171	153.7	75.0	231	207.6	101.3	291	261.5	127.6
52	46.7	22.8	12	100.7	49.1	72	154.6	75.4	32	208.5	101.7	92	262.4	128.0
53	47.6	23.2	13	101.6	49.5	73	155.5	75.8	33	209.4	102.1	93	263.3	128.4
54	48.5	23.7	14	102.5	50.0	74	156.4	76.3	34	210.3	102.6	94	264.2	128.9
55	49.4	24.1	15	103.4	50.4	75	157.3	76.7	35	211.2	103.0	95	265.1	129.3
56	50.3	24.5	16	104.3	50.9	76	158.2	77.2	36	212.1	103.5	96	266.0	129.8
57	51.2	25.0	17	105.2	51.3	77	159.1	77.6	37	213.0	103.9	97	266.9	130.2
58	52.1	25.4	18	106.1	51.7	78	160.0	78.0	38	213.9	104.3	98	267.8	130.6
59	53.0	25.9	19	107.0	52.2	79	160.9	78.5	39	214.8	104.8	99	268.7	131.1
60	53.9	26.3	20	107.9	52.6	80	161.8	78.9	40	215.7	105.2	300	269.6	131.5

Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

[For 64 Degrees.

DIFFERENCE OF LATITUDE AND DEPARTURE FOR 27°.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	0.9	0.5	61	54.4	27.7	121	107.8	54.9	181	161.3	82.2	241	214.7	109.4
2	1.8	0.9	62	55.2	28.1	22	108.7	55.4	82	162.2	82.6	42	215.6	109.9
3	2.7	1.4	63	56.1	28.6	23	109.6	55.8	83	163.1	83.1	43	216.5	110.3
4	3.6	1.8	64	57.0	29.1	24	110.5	56.3	84	163.9	83.5	44	217.4	110.8
5	4.5	2.3	65	57.9	29.5	25	111.4	56.7	85	164.8	84.0	45	218.3	111.2
6	5.3	2.7	66	58.8	30.0	26	112.3	57.2	86	165.7	84.4	46	219.2	111.7
7	6.2	3.2	67	59.7	30.4	27	113.2	57.7	87	166.6	84.9	47	220.1	112.1
8	7.1	3.6	68	60.6	30.9	28	114.0	58.1	88	167.5	85.4	48	221.0	112.6
9	8.0	4.1	69	61.5	31.3	29	114.9	58.6	89	168.4	85.8	49	221.9	113.0
10	8.9	4.5	70	62.4	31.8	30	115.8	59.0	90	169.3	86.3	50	222.8	113.5
11	9.8	5.0	71	63.3	32.2	131	116.7	59.5	191	170.2	86.7	251	223.6	114.0
12	10.7	5.4	72	64.2	32.7	32	117.6	59.9	92	171.1	87.2	52	224.5	114.4
13	11.6	5.9	73	65.0	33.1	33	118.5	60.4	93	172.0	87.6	53	225.4	114.9
14	12.5	6.4	74	65.9	33.6	34	119.4	60.8	94	172.9	88.1	54	226.3	115.3
15	13.4	6.8	75	66.8	34.0	35	120.3	61.3	95	173.7	88.5	55	227.2	115.8
16	14.3	7.3	76	67.7	34.5	36	121.2	61.7	96	174.6	89.0	56	228.1	116.2
17	15.1	7.7	77	68.6	35.0	37	122.1	62.2	97	175.5	89.4	57	229.0	116.7
18	16.0	8.2	78	69.5	35.4	38	123.0	62.7	98	176.4	89.9	58	229.9	117.1
19	16.9	8.6	79	70.4	35.9	39	123.8	63.1	99	177.3	90.3	59	230.8	117.6
20	17.8	9.1	80	71.3	36.3	40	124.7	63.6	200	178.2	90.8	60	231.7	118.0
21	18.7	9.5	81	72.2	36.8	141	125.6	64.0	201	179.1	91.3	261	232.6	118.5
22	19.6	10.0	82	73.1	37.2	42	126.5	64.5	02	180.0	91.7	62	233.4	118.9
23	20.5	10.4	83	74.0	37.7	43	127.4	64.9	03	180.9	92.2	63	234.3	119.4
24	21.4	10.9	84	74.8	38.1	44	128.3	65.4	04	181.8	92.6	64	235.2	119.9
25	22.3	11.3	85	75.7	38.6	45	129.2	65.8	05	182.7	93.1	65	236.1	120.3
26	23.2	11.8	86	76.6	39.0	46	130.1	66.3	06	183.5	93.5	66	237.0	120.8
27	24.1	12.3	87	77.5	39.5	47	131.0	66.7	07	184.4	94.0	67	237.9	121.2
28	24.9	12.7	88	78.4	40.0	48	131.9	67.2	08	185.3	94.4	68	238.8	121.7
29	25.8	13.2	89	79.3	40.4	49	132.8	67.6	09	186.2	94.9	69	239.7	122.1
30	26.7	13.6	90	80.2	40.9	50	133.7	68.1	10	187.1	95.3	70	240.6	122.6
31	27.6	14.1	91	81.1	41.3	151	134.5	68.6	211	188.0	95.8	271	241.5	123.0
32	28.5	14.5	92	82.0	41.8	52	135.4	69.0	12	188.9	96.2	72	242.4	123.5
33	29.4	15.0	93	82.9	42.2	53	136.3	69.5	13	189.8	96.7	73	243.2	123.9
34	30.3	15.4	94	83.8	42.7	54	137.2	69.9	14	190.7	97.2	74	244.1	124.4
35	31.2	15.9	95	84.6	43.1	55	138.1	70.4	15	191.6	97.6	75	245.0	124.8
36	32.1	16.3	96	85.5	43.6	56	139.0	70.8	16	192.5	98.1	76	245.9	125.3
37	33.0	16.8	97	86.4	44.0	57	139.9	71.3	17	193.3	98.5	77	246.8	125.8
38	33.9	17.3	98	87.3	44.5	58	140.8	71.7	18	194.2	99.0	78	247.7	126.2
39	34.7	17.7	99	88.2	44.9	59	141.7	72.2	19	195.1	99.4	79	248.6	126.7
40	35.6	18.2	100	89.1	45.4	60	142.6	72.6	20	196.0	99.9	80	249.5	127.1
41	36.5	18.6	101	90.0	45.9	161	143.5	73.1	221	196.9	100.3	281	250.4	127.6
42	37.4	19.1	02	90.9	46.3	62	144.3	73.5	22	197.8	100.8	82	251.3	128.0
43	38.3	19.5	03	91.8	46.8	63	145.2	74.0	23	198.7	101.2	83	252.2	128.5
44	39.2	20.0	04	92.7	47.2	64	146.1	74.5	24	199.6	101.7	84	253.0	128.9
45	40.1	20.4	05	93.6	47.7	65	147.0	74.9	25	200.5	102.1	85	253.9	129.4
46	41.0	20.9	06	94.4	48.1	66	147.9	75.4	26	201.4	102.6	86	254.8	129.8
47	41.9	21.3	07	95.3	48.6	67	148.8	75.8	27	202.3	103.1	87	255.7	130.3
48	42.8	21.8	08	96.2	49.0	68	149.7	76.3	28	203.1	103.5	88	256.6	130.7
49	43.7	22.2	09	97.1	49.5	69	150.6	76.7	29	204.0	104.0	89	257.5	131.2
50	44.6	22.7	10	98.0	49.9	70	151.5	77.2	30	204.9	104.4	90	258.4	131.7
51	45.4	23.2	111	98.9	50.4	171	152.4	77.6	231	205.8	104.9	291	259.3	132.1
52	46.3	23.6	12	99.8	50.8	72	153.3	78.1	32	206.7	105.3	92	260.2	132.6
53	47.2	24.1	13	100.7	51.3	73	154.1	78.5	33	207.6	105.8	93	261.1	133.0
54	48.1	24.5	14	101.6	51.8	74	155.0	79.0	34	208.5	106.2	94	262.0	133.5
55	49.0	25.0	15	102.5	52.2	75	155.9	79.4	35	209.4	106.7	95	262.8	133.9
56	49.9	25.4	16	103.4	52.7	76	156.8	79.9	36	210.3	107.1	96	263.7	134.4
57	50.8	25.9	17	104.2	53.1	77	157.7	80.4	37	211.2	107.6	97	264.6	134.8
58	51.7	26.3	18	105.1	53.6	78	158.6	80.8	38	212.1	108.0	98	265.5	135.3
59	52.6	26.8	19	106.0	54.0	79	159.5	81.3	39	213.0	108.5	99	266.4	135.7
60	53.5	27.2	20	106.9	54.5	80	160.4	81.7	40	213.8	109.0	300	267.3	136.2

Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

[For 63 Degrees.

DIFFERENCE OF LATITUDE AND DEPARTURE FOR 28°.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	0. 9	0. 5	61	53. 9	28. 6	121	106. 8	56. 8	181	159. 8	85. 0	241	212. 8	113. 1
2	1. 8	0. 9	62	54. 7	29. 1	22	107. 7	57. 3	82	160. 7	85. 4	42	213. 7	113. 6
3	2. 6	1. 4	63	55. 6	29. 6	23	108. 6	57. 7	83	161. 6	85. 9	43	214. 6	114. 1
4	3. 5	1. 9	64	56. 5	30. 0	24	109. 5	58. 2	84	162. 5	86. 4	44	215. 4	114. 6
5	4. 4	2. 3	65	57. 4	30. 5	25	110. 4	58. 7	85	163 3	86. 9	45	216. 3	115. 0
6	5. 3	2. 8	66	58. 3	31. 0	26	111. 3	59. 2	86	164. 2	87. 3	46	217. 2	115. 5
7	6. 2	3. 3	67	59. 2	31. 5	27	112. 1	59. 6	87	165. 1	87. 8	47	218. 1	116. 0
8	7. 1	3. 8	68	60. 0	31. 9	28	113. 0	60. 1	88	166. 0	88. 3	48	219. 0	116. 4
9	7. 9	4. 2	69	60. 9	32. 4	29	113. 9	60. 6	89	166. 9	88. 7	49	219. 9	116. 9
10	8. 8	4. 7	70	61. 8	32. 9	30	114. 8	61. 0	90	167. 8	89. 2	50	220. 7	117. 4
11	9. 7	5. 2	71	62. 7	33. 3	131	115. 7	61. 5	191	168. 6	89. 7	251	221. 6	117. 8
12	10.6	5. 6	72	63. 6	33. 8	32	116. 5	62. 0	92	169. 5	90. 1	52	222. 5	118. 3
13	11. 5	6. 1	73	64. 5	34. 3	33	117. 4	62. 4	93	170. 4	90. 6	53	223. 4	118. 8
14	12. 4	6. 6	74	65. 3	34. 7	34	118. 3	62. 9	94	171. 3	91. 1	54	224. 3	119. 2
15	13. 2	7. 0	75	66. 2	35. 2	35	119. 2	63. 4	95	172. 2	91. 5	55	225. 2	119. 7
16	14. 1	7. 5	76	67. 1	35. 7	36	120. 1	63. 8	96	173. 1	92. 0	56	226. 0	120. 2
17	15. 0	8. 0	77	68. 0	36. 1	37	121. 0	64. 3	97	173. 9	92. 5	57	226. 9	120. 7
18	15. 9	8. 5	78	68. 9	36. 6	38	121. 8	64. 8	98	174. 8	93. 0	58	227. 8	121. 1
19	16. 8	8. 9	79	69. 8	37. 1	39	122. 7	65. 3	99	175. 7	93. 4	59	228. 7	121. 6
20	17. 7	9. 4	80	70. 6	37. 6	40	123. 6	65. 7	200	176. 6	93. 9	60	229. 6	122. 1
21	18. 5	9. 9	81	71. 5	38. 0	141	124. 5	66. 2	201	177. 5	94. 4	261	230. 4	122. 5
22	19. 4	10. 3	82	72. 4	38. 5	42	125. 4	66. 7	02	178. 4	94. 8	62	231. 3	123. 0
23	20. 3	10. 8	83	73. 3	39. 0	43	126. 3	67. 1	03	179. 2	95. 3	63	232. 2	123. 5
24	21. 2	11. 3	84	74. 2	39. 4	44	127. 1	67. 6	04	180. 1	95. 8	64	233. 1	123. 9
25	22. 1	11. 7	85	75. 1	39. 9	45	128. 0	68. 1	05	181. 0	96. 2	65	234. 0	124. 4
26	23. 0	12. 2	86	75. 9	40. 4	46	128. 9	68. 5	06	181. 9	96. 7	66	234. 9	124. 9
27	23. 8	12. 7	87	76. 8	40. 8	47	129. 8	69. 0	07	182. 8	97. 2	67	235. 7	125. 3
28	24. 7	13. 1	88	77. 7	41. 3	48	130. 7	69. 5	08	183. 7	97. 7	68	236. 6	125. 8
29	25. 6	13. 6	89	78. 6	41. 8	49	131. 6	70. 0	09	184. 5	98. 1	69	237. 5	126. 3
30	26. 5	14. 1	90	79. 5	42. 3	50	132. 4	70. 4	10	185. 4	98. 6	70	238. 4	126. 8
31	27. 4	14. 6	91	80. 3	42. 7	151	133. 3	70. 9	211	186. 3	99. 1	271	239. 3	127. 2
32	28. 3	15. 0	92	81. 2	43. 2	52	134. 2	71. 4	12	187. 2	99. 5	72	240. 2	127. 7
33	29. 1	15. 5	93	82. 1	43. 7	53	135. 1	71. 8	13	188. 1	100. 0	73	241. 0	128. 2
34	30. 0	16. 0	94	83. 0	44. 1	54	136. 0	72. 3	14	189. 0	100. 5	74	241. 9	128. 6
35	30. 9	16. 4	95	83. 9	44. 6	55	136. 9	72. 8	15	189. 8	100. 9	75	242. 8	129. 1
36	31. 8	16. 9	96	84. 8	45. 1	56	137. 7	73. 2	16	190. 7	101. 4	76	243. 7	129. 6
37	32. 7	17. 4	97	85. 6	45. 5	57	138. 6	73. 7	17	191. 6	101. 9	77	244. 6	130. 0
38	33. 6	17. 8	98	86. 5	46. 0	58	139. 5	74. 2	18	192. 5	102. 3	78	245. 5	130. 5
39	34. 4	18. 3	99	87. 4	46. 5	59	140. 4	74. 6	19	193. 4	102. 8	79	246. 3	131. 0
40	35. 3	18. 8	100	88. 3	46. 9	60	141. 3	75. 1	20	194. 2	103. 3	80	247. 2	131. 5
41	36. 2	19. 2	101	89. 2	47. 4	161	142. 2	75. 6	221	195. 1	103. 8	281	248. 1	131. 9
42	37. 1	19. 7	02	90. 1	47. 9	62	143. 0	76. 1	22	196. 0	104. 2	82	249. 0	132. 4
43	38. 0	20. 2	03	90. 9	48. 4	63	143. 9	76. 5	23	196. 9	104. 7	83	249. 9	132. 9
44	38. 8	20. 7	04	91. 8	48. 8	64	144. 8	77. 0	24	197. 8	105. 2	84	250. 8	133. 3
45	39. 7	21. 1	05	92. 7	49. 3	65	145. 7	77. 5	25	198. 7	105. 6	85	251. 6	133. 8
46	40. 6	21. 6	06	93. 6	49. 8	66	146. 6	77. 9	26	199. 5	106. 1	86	252. 5	134. 3
47	41. 5	22. 1	07	94. 5	50. 2	67	147. 5	78. 4	27	200. 4	106. 6	87	253. 4	134. 7
48	42. 4	22. 5	08	95. 4	50. 7	68	148. 3	78. 9	28	201. 3	107. 0	88	254. 3	135. 2
49	43. 3	23. 0	09	96. 2	51. 2	69	149. 2	79. 3	29	202. 2	107. 5	89	255. 2	135. 7
50	44. 1	23. 5	10	97. 1	51. 6	70	150. 1	79. 8	30	203. 1	108. 0	90	256. 1	136. 1
51	45. 0	23. 9	111	98. 0	52. 1	171	151. 0	80. 3	231	204. 0	108. 4	291	256. 9	136. 6
52	45. 9	24. 4	12	98. 9	52. 6	72	151. 9	80. 7	32	204. 8	108. 9	92	257. 8	137. 1
53	46. 8	24. 9	13	99. 8	53. 1	73	152. 7	81. 2	33	205. 7	109. 4	93	258. 7	137. 6
54	47. 7	25. 4	14	100. 7	53. 5	74	153. 6	81. 7	34	206. 6	109. 9	94	259. 6	138. 0
55	48. 6	25. 8	15	101. 5	54. 0	75	154. 5	82. 2	35	207. 5	110. 3	95	260. 5	138. 5
56	49. 4	26. 3	16	102. 4	54. 5	76	155. 4	82. 6	36	208. 4	110. 8	96	261. 4	139. 0
57	50. 3	26. 8	17	103. 3	54. 9	77	156. 3	83. 1	37	209. 3	111. 3	97	262. 2	139. 4
58	51. 2	27. 2	18	104. 2	55. 4	78	157. 2	83. 6	38	210. 1	111. 7	98	263. 1	139. 9
59	52. 1	27. 7	19	105. 1	55. 9	79	158. 0	84. 0	39	211. 0	112. 2	99	264. 0	140. 4
60	53. 0	28. 2	20	106. 0	56. 3	80	158. 9	84. 5	40	211. 9	112. 7	300	264. 9	140. 8

Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	De p.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

[For 62 Degrees.

DIFFERENCE OF LATITUDE AND DEPARTURE FOR 29

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	0.9	0.5	61	53.4	29.6	121	105.8	58.7	181	158.3	87.8	241	210.8	116.8
2	1.7	1.0	62	54.2	30.1	22	106.7	59.1	82	159.2	88.2	42	211.7	117.3
3	2.6	1.5	63	55.1	30.5	23	107.6	59.6	83	160.1	88.7	43	212.5	117.8
4	3.5	1.9	64	56.0	31.0	24	108.5	60.1	84	160.9	89.2	44	213.4	118.3
5	4.4	2.4	65	56.9	31.5	25	109.3	60.6	85	161.8	89.7	45	214.3	118.8
6	5.2	2.9	66	57.7	32.0	26	110.2	61.1	86	162.7	90.2	46	215.2	119.3
7	6.1	3.4	67	58.6	32.5	27	111.1	61.6	87	163.6	90.7	47	216.0	119.7
8	7.0	3.9	68	59.5	33.0	28	112.0	62.1	88	164.4	91.1	48	216.9	120.2
9	7.9	4.4	69	60.3	33.5	29	112.8	62.5	89	165.3	91.6	49	217.8	120.7
10	8.7	4.8	70	61.2	33.9	30	113.7	63.0	90	166.2	92.1	50	218.7	121.2
11	9.6	5.3	71	62.1	34.4	131	114.6	63.5	191	167.1	92.6	251	219.5	121.7
12	10.5	5.8	72	63.0	34.9	32	115.4	64.0	92	167.9	93.1	52	220.4	122.2
13	11.4	6.3	73	63.8	35.4	33	116.3	64.5	93	168.8	93.6	53	221.3	122.7
14	12.2	6.8	74	64.7	35.9	34	117.2	65.0	94	169.7	94.1	54	222.2	123.1
15	13.1	7.3	75	65.6	36.4	35	118.1	65.4	95	170.6	94.5	55	223.0	123.6
16	14.0	7.8	76	66.5	36.8	36	118.9	65.9	96	171.4	95.0	56	223.9	124.1
17	14.9	8.2	77	67.3	37.3	37	119.8	66.4	97	172.3	95.5	57	224.8	124.6
18	15.7	8.7	78	68.2	37.8	38	120.7	66.9	98	173.2	96.0	58	225.7	125.1
19	16.6	9.2	79	69.1	38.3	39	121.6	67.4	99	174.0	96.5	59	226.5	125.6
20	17.5	9.7	80	70.0	38.8	40	122.4	67.9	200	174.9	97.0	60	227.4	126.1
21	18.4	10.2	81	70.8	39.3	141	123.3	68.4	201	175.8	97.4	261	228.3	126.5
22	19.2	10.7	82	71.7	39.8	42	124.2	68.8	02	176.7	97.9	62	229.2	127.0
23	20.1	11.2	83	72.6	40.2	43	125.1	69.3	03	177.5	98.4	63	230.0	127.5
24	21.0	11.6	84	73.5	40.7	44	125.9	69.8	04	178.4	98.9	64	230.9	128.0
25	21.9	12.1	85	74.3	41.2	45	126.8	70.3	05	179.3	99.4	65	231.8	128.5
26	22.7	12.6	86	75.2	41.7	46	127.7	70.8	06	180.2	99.9	66	232.6	129.0
27	23.6	13.1	87	76.1	42.2	47	128.6	71.3	07	181.0	100.4	67	233.5	129.4
28	24.5	13.6	88	77.0	42.7	48	129.4	71.8	08	181.9	100.8	68	234.4	129.9
29	25.4	14.1	89	77.8	43.1	49	130.3	72.2	09	182.8	101.3	69	235.3	130.4
30	26.2	14.5	90	78.7	43.6	50	131.2	72.7	10	183.7	101.8	70	236.1	130.9
31	27.1	15.0	91	79.6	44.1	151	132.1	73.2	211	184.5	102.3	271	237.0	131.4
32	28.0	15.5	92	80.5	44.6	52	132.9	73.7	12	185.4	102.8	72	237.9	131.9
33	28.9	16.0	93	81.3	45.1	53	133.8	74.2	13	186.3	103.3	73	238.8	132.4
34	29.7	16.5	94	82.2	45.6	54	134.7	74.7	14	187.2	103.7	74	239.6	132.8
35	30.6	17.0	95	83.1	46.1	55	135.6	75.1	15	188.0	104.2	75	240.5	133.3
36	31.5	17.5	96	84.0	46.5	56	136.4	75.6	16	188.9	104.7	76	241.4	133.8
37	32.4	17.9	97	84.8	47.0	57	137.3	76.1	17	189.8	105.2	77	242.3	134.3
38	33.2	18.4	98	85.7	47.5	58	138.2	76.6	18	190.7	105.7	78	243.1	134.8
39	34.1	18.9	99	86.6	48.0	59	139.0	77.1	19	191.5	106.2	79	244.0	135.3
40	35.0	19.4	100	87.5	48.5	60	139.9	77.6	20	192.4	106.7	80	244.9	135.7
41	35.9	19.9	101	88.3	49.0	161	140.8	78.1	221	193.3	107.1	281	245.8	136.2
42	36.7	20.4	02	89.2	49.5	62	141.7	78.5	22	194.2	107.6	82	246.6	136.7
43	37.6	20.8	03	90.1	49.9	63	142.6	79.0	23	195.0	108.1	83	247.5	137.2
44	38.5	21.3	04	91.0	50.4	64	143.4	79.5	24	195.9	108.6	84	248.4	137.7
45	39.4	21.8	05	91.8	50.9	65	144.3	80.0	25	196.8	109.1	85	249.3	138.2
46	40.2	22.3	06	92.7	51.4	66	145.2	80.5	26	197.7	109.6	86	250.1	138.7
47	41.1	22.8	07	93.6	51.9	67	146.1	81.0	27	198.5	110.1	87	251.0	139.1
48	42.0	23.3	08	94.5	52.4	68	146.9	81.4	28	199.4	110.5	88	251.9	139.6
49	42.9	23.8	09	95.3	52.8	69	147.8	81.9	29	200.3	111.0	89	252.8	140.1
50	43.7	24.2	10	96.2	53.3	70	148.7	82.4	30	201.2	111.5	90	253.6	140.6
51	44.6	24.7	111	97.1	53.8	171	149.6	82.9	231	202.0	112.0	291	254.5	141.1
52	45.5	25.2	12	98.0	54.3	72	150.4	83.4	32	202.9	112.5	92	255.4	141.6
53	46.4	25.7	13	98.8	54.8	73	151.3	83.9	33	203.8	113.0	93	256.3	142.0
54	47.2	26.2	14	99.7	55.3	74	152.2	84.4	34	204.7	113.4	94	257.1	142.5
55	48.1	26.7	15	100.6	55.8	75	153.1	84.8	35	205.5	113.9	95	258.0	143.0
56	49.0	27.1	16	101.5	56.2	76	153.9	85.3	36	206.4	114.4	96	258.9	143.5
57	49.9	27.6	17	102.3	56.7	77	154.8	85.8	37	207.3	114.9	97	259.8	144.0
58	50.7	28.1	18	103.2	57.2	78	155.7	86.3	38	208.2	115.4	98	260.6	144.5
59	51.6	28.6	19	104.1	57.7	79	156.6	86.8	39	209.0	115.9	99	261.5	145.0
60	52.5	29.1	20	105.0	58.2	80	157.4	87.3	40	209.9	116.4	300	262.4	145.4

Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

[For 61 Degrees.

DIFFERENCE OF LATITUDE AND DEPARTURE FOR 30°.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	0. 9	0. 5	61	52. 8	30. 5	121	104. 8	60 5	181	156. 8	90. 5	241	208. 7	120. 5
2	1. 7	1. 0	62	53. 7	31. 0	22	105. 7	61. 0	82	157. 6	91. 0	42	209. 6	121. 0
3	2. 6	1. 5	63	54. 6	31. 5	23	106. 5	61. 5	83	158. 5	91. 5	43	210. 4	121. 5
4	3. 5	2. 0	64	55. 4	32. 0	24	107. 4	62. 0	84	159. 3	92. 0	44	211. 3	122. 0
5	4. 3	2. 5	65	56. 3	32. 5	25	108. 3	62. 5	85	160. 2	92 5	45	212. 2	122. 5
6	5. 2	3. 0	66	57. 2	33. 0	26	109. 1	63. 0	86	161. 1	93. 0	46	213. 0	123. 0
7	6. 1	3. 5	67	58. 0	33. 5	27	110. 0	63. 5	87	161. 9	93. 5	47	213. 9	123. 5
8	6. 9	4. 0	68	58 9	34. 0	28	110. 9	64 0	88	162. 8	94. 0	48	214. 8	124. 0
9	7. 8	4. 5	69	59. 8	34. 5	29	111. 7	64. 5	89	163. 7	94. 5	49	215. 6	124. 5
10	8. 7	5. 0	70	60. 6	35. 0	30	112. 6	65. 0	90	164. 5	95. 0	50	216. 5	125. 0
11	9. 5	5. 5	71	61. 5	35. 5	131	113. 4	65. 5	191	165. 4	95. 5	251	217. 4	125. 5
12	10. 4	6. 0	72	62 4	36. 0	32	114. 3	66. 0	92	166. 3	96. 0	52	218. 2	126. 0
13	11. 3	6. 5	73	63. 2	36. 5	33	115. 2	66. 5	93	167. 1	96. 5	53	219. 1	126. 5
14	12. 1	7. 0	74	64. 1	37. 0	34	116. 0	67. 0	94	168. 0	97. 0	54	220. 0	127. 0
15	13. 0	7. 5	75	65 0	37. 5	35	116. 9	67. 5	95	168. 9	97. 5	55	220. 8	127. 5
16	13. 9	8. 0	76	65 8	38. 0	36	117. 8	68. 0	96	169. 7	98. 0	56	221. 7	128. 0
17	14. 7	8. 5	77	66 7	38. 5	37	118. 6	68. 5	97	170. 6	98. 5	57	222. 6	128. 5
18	15. 6	9. 0	78	67. 5	39. 0	38	119. 5	69. 0	98	171. 5	99. 0	58	223. 4	129. 0
19	16. 5	9. 5	79	68 4	39. 5	39	120. 4	69. 5	99	172. 3	99. 5	59	224. 3	129. 5
20	17. 3	10. 0	80	69. 3	40. 0	40	121. 2	70. 0	200	173. 2	100. 0	60	225. 2	130. 0
21	18. 2	10. 5	81	70 1	40. 5	141	122. 1	70. 5	201	174. 1	100. 5	261	226. 0	130. 5
22	19. 1	11 0	82	71. 0	41. 0	42	123. 0	71. 0	02	174. 9	101. 0	62	226. 9	131. 0
23	19. 9	11. 5	83	71 9	41. 5	43	123. 8	71. 5	03	175. 8	101. 5	63	227. 8	131. 5
24	20. 8	12. 0	84	72 7	42. 0	44	124. 7	72. 0	04	176. 7	102. 0	64	228. 6	132 0
25	21. 7	12. 5	85	73 6	42. 5	45	125. 6	72. 5	05	177. 5	102. 5	65	229. 5	132. 5
26	22. 5	13. 0	86	74. 5	43. 0	46	126. 4	73. 0	06	178. 4	103. 0	66	230. 4	133. 0
27	23. 4	13. 5	87	75 3	43. 5	47	127. 3	73. 5	07	179. 3	103. 5	67	231. 2	133. 5
28	24. 2	14. 0	88	76 2	44. 0	48	128. 2	74. 0	08	180. 1	104. 0	68	232. 1	134. 0
29	25. 1	14. 5	89	77. 1	44. 5	49	129. 0	74. 5	09	181. 0	104. 5	69	233. 0	134. 5
30	26. 0	15. 0	90	77. 9	45. 0	50	129. 9	75. 0	10	181. 9	105. 0	70	233. 8	135. 0
31	26. 8	15. 5	91	78. 8	45. 5	151	130. 8	75. 5	211	182. 7	105. 5	271	234. 7	135. 5
32	27. 7	16. 0	92	79 7	46. 0	52	131. 6	76. 0	12	183. 6	106. 0	72	235. 6	136. 0
33	28. 6	16. 5	93	80. 5	46. 5	53	132. 5	76. 5	13	184. 5	106. 5	73	236. 4	136. 5
34	29. 4	17. 0	94	81 4	47. 0	54	133. 4	77. 0	14	185. 3	107. 0	74	237. 3	137. 0
35	30. 3	17. 5	95	82. 3	47. 5	55	134. 2	77. 5	15	186. 2	107. 5	75	238. 2	137. 5
36	31. 2	18. 9	96	83. 1	48. 0	56	135. 1	78. 0	16	187. 1	108. 0	76	239. 0	138. 0
37	32. 0	18. 5	97	84. 0	48. 5	57	136. 0	78. 5	17	187. 9	108. 5	77	239. 9	138. 5
38	32. 9	19. 0	98	84. 9	49. 0	58	136. 8	79. 0	18	188. 8	109. 0	78	240. 8	139. 0
39	33. 8	19. 5	99	85. 7	49. 5	59	137. 7	79. 5	19	189. 7	109. 5	79	241. 6	139. 5
40	34. 6	20. 0	100	86. 6	50. 0	60	138. 6	80. 0	20	190. 5	110. 0	80	242. 5	140. 0
41	35. 5	20. 5	101	87. 5	50. 5	161	139. 4	80. 5	221	191. 4	110. 5	281	243. 4	140. 5
42	36. 4	21. 0	02	88. 3	51. 0	62	140. 3	81. 0	22	192. 3	111. 0	82	244. 2	141. 0
43	37. 2	21. 5	03	89. 2	51. 5	63	141. 2	81. 5	23	193. 1	111. 5	83	245. 1	141. 5
44	38. 1	22. 0	04	90. 1	52. 0	64	142. 0	82. 0	24	194. 0	112. 0	84	246. 0	142. 0
45	39. 0	22. 5	05	90. 9	52. 5	65	142. 9	82. 5	25	194. 9	112. 5	85	246. 8	142. 5
46	39. 8	23. 0	06	91. 8	53. 0	66	143. 8	83. 0	26	195. 7	113. 0	86	247. 7	143. 0
47	40. 7	23. 5	07	92. 7	53. 5	67	144. 6	83. 5	27	196. 6	113. 5	87	248. 5	143. 5
48	41. 6	24. 0	08	93. 5	54. 0	68	145. 5	84. 0	28	197. 5	114. 0	88	249. 4	144. 0
49	42. 4	24. 5	09	94. 4	54. 5	69	146. 4	84. 5	29	198. 3	114. 5	89	250. 3	144. 5
50	43. 3	25. 0	10	95. 3	55. 0	70	147. 2	85. 0	30	199. 2	115. 0	90	251. 1	145. 0
51	44. 2	25. 5	111	96. 1	55. 5	171	148. 1	85. 5	231	200. 1	115. 5	291	252. 0	145. 5
52	45. 0	26. 0	12	97. 0	56. 0	72	149. 0	86. 0	32	200. 9	116. 0	92	252. 9	146. 0
53	45. 9	26. 5	13	97. 9	56. 5	73	149. 8	86. 5	33	201. 8	116. 5	93	253 7	146. 5
54	46. 8	27. 0	14	98. 7	57. 0	74	150. 7	87. 0	34	202. 6	117. 0	94	254. 6	147. 0
55	47. 6	27. 5	15	99. 6	57. 5	75	151. 6	87. 5	35	203. 5	117. 5	95	255. 5	147. 5
56	48. 5	28. 0	16	100. 5	58. 0	76	152. 4	88. 0	36	204. 4	118. 0	96	256. 3	148. 0
57	49. 4	28. 5	17	101. 3	58. 5	77	153. 3	88. 5	37	205. 2	118. 5	97	257. 2	148. 5
58	50. 2	29. 0	18	102. 2	59. 0	78	154. 2	89. 0	38	206. 1	119. 0	98	258. 1	149. 0
59	51. 1	29. 5	19	103. 1	59. 5	79	155. 0	89. 5	39	207. 0	119. 5	99	258. 9	149. 5
60	52. 0	30. 0	20	103. 9	60. 0	80	155. 9	90. 0	40	207. 8	120. 0	300	259. 8	150. 0

Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

[For 60 Degrees.

DIFFERENCE OF LATITUDE AND DEPARTURE FOR 31°.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep
1	0.9	0.5	61	52.3	31.4	121	103.7	62.3	181	155.1	93.2	241	206.6	124.1
2	1.7	1.0	62	53.1	31.9	22	104.6	62.8	82	156.0	93.7	42	207.4	124.6
3	2.6	1.5	63	54.0	32.4	23	105.4	63.3	83	150.9	94.3	43	208.3	125.2
4	3.4	2.1	64	54.9	33.0	24	106.3	63.9	84	157.7	94.8	44	209.1	125.7
5	4.3	2.6	65	55.7	33.5	25	107.1	64.4	85	158.6	95.3	45	210.0	126.2
6	5.1	3.1	66	56.6	34.0	26	108.0	64.9	86	159.4	95.8	46	210.9	126.7
7	6.0	3.6	67	57.4	34.5	27	108.9	65.4	87	160.3	96.3	47	211.7	127.2
8	6.9	4.1	68	58.3	35.0	28	109.7	65.9	88	161.1	96.8	48	212.6	127.7
9	7.7	4.6	69	59.1	35.5	29	110.6	66.4	89	162.0	97.3	49	213.4	128.2
10	8.6	5.2	70	60.0	36.1	30	111.4	67.0	90	162.9	97.9	50	214.3	128.8
11	9.4	5.7	71	60.9	36.6	131	112.3	67.5	191	163.7	98.4	251	215.1	129.3
12	10.3	6.2	72	61.7	37.1	32	113.1	68.0	92	164.6	98.9	52	216.0	129.8
13	11.1	6.7	73	62.6	37.6	33	114.0	68.5	93	165.4	99.4	53	216.9	130.3
14	12.0	7.2	74	63.4	38.1	34	114.9	69.0	94	166.3	99.9	54	217.7	130.8
15	12.9	7.7	75	64.3	38.6	35	115.7	69.5	95	167.1	100.4	55	218.6	131.3
16	13.7	8.2	76	65.1	39.1	36	116.6	70.0	96	168.0	100.9	56	219.4	131.8
17	14.6	8.8	77	66.0	39.7	37	117.4	70.6	97	168.9	101.5	57	220.3	132.4
18	15.4	9.3	78	66.9	40.2	38	118.3	71.1	98	169.7	102.0	58	221.1	132.9
19	16.3	9.8	79	67.7	40.7	39	119.1	71.6	99	170.6	102.5	59	222.0	133.4
20	17.1	10.3	80	68.6	41.2	40	120.0	72.1	200	171.4	103.0	60	222.9	133.9
21	18.0	10.8	81	69.4	41.7	141	120.9	72.6	201	172.3	103.5	261	223.7	134.4
22	18.9	11.3	82	70.3	42.2	42	121.7	73.1	02	173.1	104.0	62	224.6	134.9
23	19.7	11.8	83	71.1	42.7	43	122.6	73.7	03	174.0	104.6	63	225.4	135.5
24	20.6	12.4	84	72.0	43.3	44	123.4	74.2	04	174.9	105.1	64	226.3	136.0
25	21.4	12.9	85	72.9	43.8	45	124.3	74.7	05	175.7	105.6	65	227.1	136.5
26	22.3	13.4	86	73.7	44.3	46	125.1	75.2	06	176.6	106.1	66	228.0	137.0
27	23.1	13.9	87	74.6	44.8	47	126.0	75.7	07	177.4	106.6	67	228.9	137.5
28	24.0	14.4	88	75.4	45.3	48	126.9	76.2	08	178.3	107.1	68	229.7	138.0
29	24.9	14.9	89	76.3	45.8	49	127.7	76.7	09	179.1	107.6	69	230.6	138.5
30	25.7	15.5	90	77.1	46.4	50	128.6	77.3	10	180.0	108.2	70	231.4	139.1
31	26.6	16.0	91	78.0	46.9	151	129.4	77.8	211	180.9	108.7	271	232.3	139.6
32	27.4	16.5	92	78.9	47.4	52	130.3	78.3	12	181.7	109.2	72	233.1	140.1
33	28.3	17.0	93	79.7	47.9	53	131.1	78.8	13	182.6	109.7	73	234.0	140.6
34	29.1	17.5	94	80.6	48.4	54	132.0	79.3	14	183.4	110.2	74	234.9	141.1
35	30.0	18.0	95	81.4	48.9	55	132.9	79.8	15	184.3	110.7	75	235.7	141.6
36	30.9	18.5	96	82.3	49.4	56	133.7	80.3	16	185.1	111.2	76	236.6	142.2
37	31.7	19.1	97	83.1	50.0	57	134.6	80.9	17	186.0	111.8	77	237.4	142.7
38	32.6	19.6	98	84.0	50.5	58	135.4	81.4	18	186.9	112.3	78	238.3	143.2
39	33.4	20.1	99	84.9	51.0	59	136.3	81.9	19	187.7	112.8	79	239.1	143.7
40	34.3	20.6	100	85.7	51.5	60	137.1	82.4	20	188.6	113.3	80	240.0	144.2
41	35.1	21.1	101	86.6	52.0	161	138.0	82.9	221	189.4	113.8	281	240.9	144.7
42	36.0	21.6	02	87.4	52.5	62	138.9	83.4	22	190.3	114.3	82	241.7	145.2
43	36.9	22.1	03	88.3	53.0	63	139.7	84.0	23	191.1	114.9	83	242.6	145.8
44	37.7	22.7	04	89.1	53.6	64	140.6	84.5	24	192.0	115.4	84	243.4	146.3
45	38.6	23.2	05	90.0	54.1	65	141.4	85.0	25	192.9	115.9	85	244.3	146.8
46	39.4	23.7	06	90.9	54.6	66	142.3	85.5	26	193.7	116.4	86	245.1	147.3
47	40.3	24.2	07	91.7	55.1	67	143.1	86.0	27	194.6	116.9	87	246.0	147.8
48	41.1	24.7	08	92.6	55.6	68	144.0	86.5	28	195.4	117.4	88	246.9	148.3
49	42.0	25.2	09	93.4	56.1	69	144.9	87.0	29	196.3	117.9	89	247.7	148.8
50	42.9	25.8	10	94.3	56.7	70	145.7	87.6	30	197.1	118.5	90	248.6	149.4
51	43.7	26.3	111	95.1	57.2	171	146.6	88.1	231	198.0	119.0	291	249.4	149.9
52	44.6	26.8	12	96.0	57.7	72	147.4	88.6	32	198.9	119.5	92	250.3	150.4
53	45.4	27.3	13	96.9	58.2	73	148.3	89.1	33	199.7	120.0	93	251.2	150.9
54	46.3	27.8	14	97.7	58.7	74	149.1	89.6	34	200.6	120.5	94	252.0	151.4
55	47.1	28.3	15	98.6	59.2	75	150.0	90.1	35	201.4	121.0	95	252.9	151.9
56	48.0	28.8	16	99.4	59.7	76	150.9	90.6	36	202.3	121.5	96	253.7	152.5
57	48.9	29.4	17	100.3	60.3	77	151.7	91.2	37	203.1	122.1	97	254.6	153.0
58	49.7	29.9	18	101.1	60.8	78	152.6	91.7	38	204.0	122.6	98	255.4	153.5
59	50.6	30.4	19	102.0	61.3	79	153.4	92.2	39	204.9	123.1	99	256.3	154.0
60	51.4	30.9	20	102.9	61.8	80	154.3	92.7	40	205.7	123.6	300	257.1	154.5

Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

[For 59 Degrees.

DIFFERENCE OF LATITUDE AND DEPARTURE FOR 32°.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	0. 8	0. 5	61	51. 7	32. 3	121	102. 6	64. 1	181	153. 5	95. 9	241	204. 4	127. 7
2	1. 7	1. 1	62	52. 6	32. 9	22	103. 5	64. 7	82	154. 3	96. 4	42	205. 2	128. 2
3	2. 5	1. 6	63	53. 4	33. 4	23	104. 3	65. 2	83	155. 2	97. 0	43	206. 1	128. 8
4	3. 4	2. 1	64	54. 3	33. 9	24	105. 2	65. 7	84	156. 0	97. 5	44	206. 9	129. 3
5	4. 2	2. 6	65	55. 1	34. 4	25	106. 0	66. 2	85	156. 9	98. 0	45	207. 8	129. 8
6	5. 1	3. 2	66	56. 0	35. 0	26	106. 9	66. 8	86	157 7	98. 6	46	208. 6	130. 4
7	5. 9	3. 7	67	56. 8	35. 5	27	107. 7	67. 3	87	158. 6	99. 1	47	209. 5	130. 9
8	6. 8	4. 2	68	57. 7	36. 0	28	108. 6	67. 8	88	159. 4	99. 6	48	210. 3	131. 4
9	7. 6	4. 8	69	58. 5	36. 6	29	109. 4	68. 4	89	160. 3	100. 2	49	211. 2	131. 9
10	8. 5	5. 3	70	59. 4	37. 1	30	110. 2	68. 9	90	161 1	100. 7	50	212. 0	132. 5
11	9. 3	5. 8	71	60. 2	37. 6	131	111. 1	69. 4	191	162 0	101. 2	251	212. 9	133. 0
12	10. 2	6. 4	72	61. 1	38. 2	32	111. 9	69. 9	92	162. 8	101. 7	52	213. 7	133. 5
13	11. 0	6. 9	73	61. 9	38. 7	33	112. 8	70. 5	93	163. 7	102. 3	53	214. 6	134. 1
14	11. 9	7. 4	74	62. 8	39. 2	34	113. 6	71 0	94	164. 5	102 8	54	215. 4	134. 6
15	12. 7	7. 9	75	63. 6	39. 7	35	114. 5	71. 5	95	165. 4	103. 3	55	216. 3	135. 1
16	13. 6	8. 5	76	64. 5	40. 3	36	115. 3	72. 1	96	166. 2	103. 9	56	217 1	135. 7
17	14. 4	9. 0	77	65. 3	40. 8	37	116. 2	72. 6	97	167. 1	104. 4	57	217. 9	136. 2
18	15. 3	9. 5	78	66. 1	41. 3	38	117. 0	73 1	98	167 9	104. 9	58	218. 8	136. 7
19	16. 1	10. 1	79	67. 0	41. 9	39	117. 9	73. 7	99	168. 8	105. 5	59	219. 6	137. 2
20	17. 0	10. 6	80	67. 8	42. 4	40	118. 7	74. 2	200	169. 6	106. 0	60	220. 5	137. 8
21	17. 8	11. 1	81	68. 7	42. 9	141	119. 6	74. 7	201	170. 5	106. 5	261	221. 3	138. 3
22	18. 7	11. 7	82	69. 5	43. 5	42	120. 4	75. 2	02	171. 3	107 0	62	222. 2	138. 8
23	19. 5	12. 2	83	70. 4	44. 0	43	121. 3	75. 8	03	172. 2	107. 6	63	223. 0	139. 4
24	20. 4	12. 7	84	71. 2	44. 5	44	122. 1	76. 3	04	173. 0	108. 1	64	223. 9	139. 9
25	21. 2	13. 2	85	72. 1	45. 0	45	123. 0	76. 8	05	173. 8	108. 6	65	224. 7	140. 4
26	22. 0	13. 8	86	72. 9	45. 6	46	123. 8	77. 4	06	174. 7	109. 2	66	225. 6	141. 0
27	22. 9	14. 3	87	73. 8	46. 1	47	124. 7	77. 9	07	175. 5	109. 7	67	226. 4	141. 5
28	23. 7	14. 8	88	74. 6	46. 6	48	125. 5	78. 4	08	176. 4	110. 2	68	227. 3	142. 0
29	24. 6	15. 4	89	75. 5	47. 2	49	126. 4	79. 0	09	177. 2	110. 8	69	228. 1	142. 5
30	25. 4	15. 9	90	76. 3	47. 7	50	127. 2	79. 5	10	178 1	111. 3	70	229. 0	143. 1
31	26. 3	16. 4	91	77. 2	48. 2	151	128. 1	80. 0	211	178. 9	111. 8	271	229. 8	143. 6
32	27. 1	17. 0	92	78. 0	48. 8	52	128. 9	80. 5	12	179. 8	112. 3	72	230. 7	144. 1
33	28. 0	17. 5	93	78. 9	49. 3	53	129. 8	81. 1	13	180. 6	112. 9	73	231. 5	144. 7
34	28. 8	18. 0	94	79. 7	49. 8	54	130. 6	81. 6	14	181. 5	113. 4	74	232 4	145. 2
35	29. 7	18. 5	95	80. 6	50. 3	55	131. 4	82. 1	15	182 3	113. 9	75	233. 2	145. 7
36	30. 5	19. 1	96	81. 4	50. 9	56	132. 3	82. 7	16	183. 2	114. 5	76	234. 1	146. 3
37	31. 4	19. 6	97	82. 3	51. 4	57	133. 1	83. 2	17	184. 0	115. 0	77	234. 9	146. 8
38	32. 2	20. 1	98	83. 1	51. 9	58	134. 0	83. 7	18	184. 9	115. 5	78	235. 8	147. 3
39	33. 1	20. 7	99	84. 0	52. 5	59	134. 8	84. 3	19	185. 7	116. 1	79	236. 6	147. 8
40	33. 9	21. 2	100	84. 8	53. 0	60	135. 7	84. 8	20	186. 6	116. 6	80	237. 5	148. 4
41	34. 8	21. 7	101	85. 7	53. 5	161	136. 5	85. 3	221	187. 4	117. 1	281	238. 3	148. 9
42	35. 6	22. 3	02	86. 5	54. 1	62	137. 4	85. 8	22	188. 3	117. 6	82	239. 1	149. 4
43	36. 5	22. 8	03	87. 3	54. 6	63	138. 2	86. 4	23	189. 1	118. 2	83	240. 0	150. 0
44	37. 3	23. 3	04	88. 2	55. 1	64	139. 1	86. 9	24	190. 0	118. 7	84	240. 8	150. 5
45	38. 2	23. 8	05	89. 0	55. 6	65	139. 9	87. 4	25	190. 8	119. 2	85	241. 7	151. 0
46	39. 0	24. 4	06	89. 9	56. 2	66	140. 8	88. 0	26	191. 7	119. 8	86	242. 5	151. 6
47	39. 9	24. 9	07	90. 7	56. 7	67	141. 6	88. 5	27	192. 5	120. 3	87	243. 4	152. 1
48	40. 7	25. 4	08	91. 6	57. 2	68	142. 5	89. 0	28	193. 4	120. 8	88	244. 2	152. 6
49	41. 6	26. 0	09	92. 4	57. 8	69	143. 3	89. 6	29	194. 2	121. 4	89	245. 1	153. 1
50	42. 4	26. 5	10	93. 3	58. 3	70	144. 2	90. 1	30	195. 1	121. 9	90	245. 9	153. 7
51	43. 3	27. 0	111	94. 1	58. 8	171	145. 0	90. 6	231	195. 9	122. 4	291	246. 8	154. 2
52	44. 1	27. 6	12	95. 0	59. 4	72	145. 9	91. 1	32	196. 7	122. 9	92	247. 6	154. 7
53	44. 9	28 1	13	95. 8	59. 9	73	146. 7	91. 7	33	197. 6	123. 5	93	248. 5	155. 3
54	45. 8	28. 6	14	96. 7	60. 4	74	147. 6	92. 2	34	198. 4	124. 0	94	249. 3	155. 8
55	46. 6	29. 1	15	97. 5	60. 9	75	148. 4	92. 7	35	199. 3	124. 5	95	250. 2	156. 3
56	47. 5	29. 7	16	98. 4	61. 5	76	149. 3	93. 3	36	200. 1	125. 1	96	251. 0	156. 9
57	48 3	30. 2	17	99. 2	62. 0	77	150. 1	93. 8	37	201 0	125. 6	97	251. 9	157. 4
58	49. 2	30. 7	18	100. 1	62. 5	78	151. 0	94. 3	38	201. 8	126. 1	98	252. 7	157. 9
59	50. 0	31. 3	19	100. 9	63. 1	79	151. 8	94. 9	39	202. 7	126. 7	99	253. 6	158. 4
60	50. 9	31. 8	20	101. 8	63. 6	80	152. 6	95. 4	40	203. 5	127. 2	300	254. 4	159. 0

Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

[For 58 Degrees.]

DIFFERENCE OF LATITUDE AND DEPARTURE FOR 33°.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	0.8	0.5	61	51.2	33.2	121	101.5	65.9	181	151.8	98.6	241	202.1	131.3
2	1.7	1.1	62	52.0	33.8	22	102.3	66.4	82	152.6	99.1	42	203.0	131.8
3	2.5	1.6	63	52.8	34.3	23	103.2	67.0	83	153.5	99.7	43	203.8	132.3
4	3.4	2.2	64	53.7	34.9	24	104.0	67.5	84	154.3	100.2	44	204.6	132.9
5	4.2	2.7	65	54.5	35.4	25	104.8	68.1	85	155.2	100.8	45	205.5	133.4
6	5.0	3.3	66	55.4	35.9	26	105.7	68.6	86	156.0	101.3	46	206.3	134.0
7	5.9	3.8	67	56.2	36.5	27	106.5	69.2	87	156.8	101.8	47	207.2	134.5
8	6.7	4.4	68	57.0	37.0	28	107.3	69.7	88	157.7	102.4	48	208.0	135.1
9	7.5	4.9	69	57.9	37.6	29	108.2	70.3	89	158.5	102.9	49	208.8	135.6
10	8.4	5.4	70	58.7	38.1	30	109.0	70.8	90	159.3	103.5	50	209.7	136.2
11	9.2	6.0	71	59.5	38.7	131	109.9	71.3	191	160.2	104.0	251	210.5	136.7
12	10.1	6.5	72	60.4	39.2	32	110.7	71.9	92	161.0	104.6	52	211.3	137.2
13	10.9	7.1	73	61.2	39.8	33	111.5	72.4	93	161.9	105.1	53	212.2	137.8
14	11.7	7.6	74	62.1	40.3	34	112.4	73.0	94	162.7	105.7	54	213.0	138.3
15	12.6	8.2	75	62.9	40.8	35	113.2	73.5	95	163.5	106.2	55	213.9	138.9
16	13.4	8.7	76	63.7	41.4	36	114.1	74.1	96	164.4	106.7	56	214.7	139.4
17	14.3	9.3	77	64.6	41.9	37	114.9	74.6	97	165.2	107.3	57	215.5	140.0
18	15.1	9.8	78	65.4	42.5	38	115.7	75.2	98	166.1	107.8	58	216.4	140.5
19	15.9	10.3	79	66.3	43.0	39	116.6	75.7	99	166.9	108.4	59	217.2	141.1
20	16.8	10.9	80	67.1	43.6	40	117.4	76.2	200	167.7	108.9	60	218.1	141.6
21	17.6	11.4	81	67.9	44.1	141	118.3	76.8	201	168.6	109.5	261	218.9	142.2
22	18.5	12.0	82	68.8	44.7	42	119.1	77.3	02	169.4	110.0	62	219.7	142.7
23	19.3	12.5	83	69.6	45.2	43	119.9	77.9	03	170.3	110.6	63	220.6	143.2
24	20.1	13.1	84	70.4	45.7	44	120.8	78.4	04	171.1	111.1	64	221.4	143.8
25	21.0	13.6	85	71.3	46.3	45	121.6	79.0	05	171.9	111.7	65	222.2	144.3
26	21.8	14.2	86	72.1	46.8	46	122.4	79.5	06	172.8	112.2	66	223.1	144.9
27	22.6	14.7	87	73.0	47.4	47	123.3	80.1	07	173.6	112.7	67	223.9	145.4
28	23.5	15.2	88	73.8	47.9	48	124.1	80.6	08	174.4	113.3	68	224.8	146.0
29	24.3	15.8	89	74.6	48.5	49	125.0	81.2	09	175.3	113.8	69	225.6	146.5
30	25.2	16.3	90	75.5	49.0	50	125.8	81.7	10	176.1	114.4	70	226.4	147.1
31	26.0	16.9	91	76.3	49.6	151	126.6	82.2	211	177.0	114.9	271	227.3	147.6
32	26.8	17.4	92	77.2	50.1	52	127.5	82.8	12	177.8	115.5	72	228.1	148.1
33	27.7	18.0	93	78.0	50.7	53	128.3	83.3	13	178.6	116.0	73	229.0	148.7
34	28.5	18.5	94	78.8	51.2	54	129.2	83.9	14	179.5	116.6	74	229.8	149.2
35	29.4	19.1	95	79.7	51.7	55	130.0	84.4	15	180.3	117.1	75	230.6	149.8
36	30.2	19.6	96	80.5	52.3	56	130.8	85.0	16	181.2	117.6	76	231.5	150.3
37	31.0	20.2	97	81.4	52.8	57	131.7	85.5	17	182.0	118.2	77	232.3	150.9
38	31.9	20.7	98	82.2	53.4	58	132.5	86.1	18	182.8	118.7	78	233.2	151.4
39	32.7	21.2	99	83.0	53.9	59	133.3	86.6	19	183.7	119.3	79	234.0	152.0
40	33.5	21.8	100	83.9	54.5	60	134.2	87.1	20	184.5	119.8	80	234.8	152.5
41	34.4	22.3	101	84.7	55.0	161	135.0	87.7	221	185.3	120.4	281	235.7	153.0
42	35.2	22.9	02	85.5	55.6	62	135.9	88.2	22	186.2	120.9	82	236.5	153.6
43	36.1	23.4	03	86.4	56.1	63	136.7	88.8	23	187.0	121.5	83	237.3	154.1
44	36.9	24.0	04	87.2	56.6	64	137.5	89.3	24	187.9	122.0	84	238.2	154.7
45	37.7	24.5	05	88.1	57.2	65	138.4	89.9	25	188.7	122.5	85	239.0	155.2
46	38.6	25.1	06	88.9	57.7	66	139.2	90.4	26	189.5	123.1	86	239.9	155.8
47	39.4	25.6	07	89.7	58.3	67	140.1	91.0	27	190.4	123.6	87	240.7	156.3
48	40.3	26.1	08	90.6	58.8	68	140.9	91.5	28	191.2	124.2	88	241.5	156.9
49	41.1	26.7	09	91.4	59.4	69	141.7	92.0	29	192.1	124.7	89	242.4	157.4
50	41.9	27.2	10	92.3	59.9	70	142.6	92.6	30	192.9	125.3	90	243.2	157.9
51	42.8	27.8	111	93.1	60.5	171	143.4	93.1	231	193.7	125.8	291	244.1	158.5
52	43.6	28.3	12	93.9	61.0	72	144.3	93.7	32	194.6	126.4	92	244.9	159.0
53	44.4	28.9	13	94.8	61.5	73	145.1	94.2	33	195.4	126.9	93	245.7	159.6
54	45.3	29.4	14	95.6	62.1	74	145.9	94.8	34	196.2	127.4	94	246.6	160.1
55	46.1	30.0	15	96.4	62.6	75	146.8	95.3	35	197.1	128.0	95	247.4	160.7
56	47.0	30.5	16	97.3	63.2	76	147.6	95.9	36	197.9	128.5	96	248.2	161.2
57	47.8	31.0	17	98.1	63.7	77	148.4	96.4	37	198.8	129.1	97	249.1	161.8
58	48.6	31.6	18	99.0	64.3	78	149.3	96.9	38	199.6	129.6	98	249.9	162.3
59	49.5	32.1	19	99.8	64.8	79	150.1	97.5	39	200.4	130.2	99	250.8	162.8
60	50.3	32.7	20	100.6	65.4	80	151.0	98.0	40	201.3	130.7	300	251.6	163.4

Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

[For 57 Degrees.

DIFFERENCE OF LATITUDE AND DEPARTURE FOR 31°.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	0.8	0.6	61	50.6	34.1	121	100.3	67.7	181	150.1	101.2	241	199.8	134.8
2	1.7	1.1	62	51.4	34.7	22	101.1	68.2	82	150.9	101.8	42	200.6	135.3
3	2.5	1.7	63	52.2	35.2	23	102.0	68.8	83	151.7	102.3	43	201.5	135.9
4	3.3	2.2	64	53.1	35.8	24	102.8	69.3	84	152.5	102.9	44	202.3	136.4
5	4.1	2.8	65	53.9	36.3	25	103.6	69.9	85	153.4	103.5	45	203.1	137.0
6	5.0	3.4	66	54.7	36.9	26	104.5	70.5	86	154.2	104.0	46	203.9	137.6
7	5.8	3.9	67	55.5	37.5	27	105.3	71.0	87	155.0	104.6	47	204.8	138.1
8	6.6	4.5	68	56.4	38.0	28	106.1	71.6	88	155.9	105.1	48	205.6	138.7
9	7.5	5.0	69	57.2	38.6	29	106.9	72.1	89	156.7	105.7	49	206.4	139.2
10	8.3	5.6	70	58.0	39.1	30	107.8	72.7	90	157.5	106.2	50	207.3	139.8
11	9.1	6.2	71	58.9	39.7	131	108.6	73.3	191	158.3	106.8	251	208.1	140.4
12	9.9	6.7	72	59.7	40.3	32	109.4	73.8	92	159.2	107.4	52	208.9	140.9
13	10.8	7.3	73	60.5	40.8	33	110.3	74.4	93	160.0	107.9	53	209.7	141.5
14	11.6	7.8	74	61.3	41.4	34	111.1	74.9	94	160.8	108.5	54	210.6	142.0
15	12.4	8.4	75	62.2	41.9	35	111.9	75.5	95	161.7	109.0	55	211.4	142.6
16	13.3	8.9	76	63.0	42.5	36	112.7	76.1	96	162.5	109.6	56	212.2	143.2
17	14.1	9.5	77	63.8	43.1	37	113.6	76.6	97	163.3	110.2	57	213.1	143.7
18	14.9	10.1	78	64.7	43.6	38	114.4	77.2	98	164.1	110.7	58	213.9	144.3
19	15.8	10.6	79	65.5	44.2	39	115.2	77.7	99	165.0	111.3	59	214.7	144.8
20	16.6	11.2	80	66.3	44.7	40	116.1	78.3	200	165.8	111.8	60	215.5	145.4
21	17.4	11.7	81	67.2	45.3	141	116.9	78.8	201	166.6	112.4	261	216.4	145.9
22	18.2	12.3	82	68.0	45.9	42	117.7	79.4	02	167.5	113.0	62	217.2	146.5
23	19.1	12.9	83	68.8	46.4	43	118.6	80.0	03	168.3	113.5	63	218.0	147.1
24	19.9	13.4	84	69.6	47.0	44	119.4	80.5	04	169.1	114.1	64	218.9	147.6
25	20.7	14.0	85	70.5	47.5	45	120.2	81.1	05	170.0	114.6	65	219.7	148.2
26	21.6	14.5	86	71.3	48.1	46	121.0	81.6	06	170.8	115.2	66	220.5	148.7
27	22.4	15.1	87	72.1	48.6	47	121.9	82.2	07	171.6	115.8	67	221.4	149.3
28	23.2	15.7	88	73.0	49.2	48	122.7	82.8	08	172.4	116.3	68	222.2	149.9
29	24.0	16.2	89	73.8	49.8	49	123.5	83.3	09	173.3	116.9	69	223.0	150.4
30	24.9	16.8	90	74.6	50.3	50	124.4	83.9	10	174.1	117.4	70	223.8	151.0
31	25.7	17.3	91	75.4	50.9	151	125.2	84.4	211	174.9	118.0	271	224.7	151.5
32	26.5	17.9	92	76.3	51.4	52	126.0	85.0	12	175.8	118.5	72	225.5	152.1
33	27.4	18.5	93	77.1	52.0	53	126.8	85.6	13	176.6	119.1	73	226.3	152.7
34	28.2	19.0	94	77.9	52.6	54	127.7	86.1	14	177.4	119.7	74	227.2	153.2
35	29.0	19.6	95	78.8	53.1	55	128.5	86.7	15	178.2	120.2	75	228.0	153.8
36	29.8	20.1	96	79.6	53.7	56	129.3	87.2	16	179.1	120.8	76	228.8	154.3
37	30.7	20.7	97	80.4	54.2	57	130.2	87.8	17	179.9	121.3	77	229.6	154.9
38	31.5	21.2	98	81.2	54.8	58	131.0	88.4	18	180.7	121.9	78	230.5	155.5
39	32.3	21.8	99	82.1	55.4	59	131.8	88.9	19	181.6	122.5	79	231.3	156.0
40	33.2	22.4	100	82.9	55.9	60	132.6	89.5	20	182.4	123.0	80	232.1	156.6
41	34.0	22.9	101	83.7	56.5	161	133.5	90.0	221	183.2	123.6	281	233.0	157.1
42	34.8	23.5	02	84.6	57.0	62	134.3	90.6	22	184.0	124.1	82	233.8	157.7
43	35.6	24.0	03	85.4	57.6	63	135.1	91.1	23	184.9	124.7	83	234.6	158.3
44	36.5	24.6	04	86.2	58.2	64	136.0	91.7	24	185.7	125.3	84	235.4	158.8
45	37.3	25.2	05	87.0	58.7	65	136.8	92.3	25	186.5	125.8	85	236.3	159.4
46	38.1	25.7	06	87.9	59.3	66	137.6	92.8	26	187.4	126.4	86	237.1	159.9
47	39.0	26.3	07	88.7	59.8	67	138.4	93.4	27	188.2	126.9	87	237.9	160.5
48	39.8	26.8	08	89.5	60.4	68	139.3	93.9	28	189.0	127.5	88	238.8	161.0
49	40.6	27.4	09	90.4	61.0	69	140.1	94.5	29	189.8	128.1	89	239.6	161.6
50	41.5	28.0	10	91.2	61.5	70	140.9	95.1	30	190.7	128.6	90	240.4	162.2
51	42.3	28.5	111	92.0	62.1	171	141.8	95.6	231	191.5	129.2	291	241.2	162.7
52	43.1	29.1	12	92.9	62.6	72	142.6	96.2	32	192.3	129.7	92	242.1	163.3
53	43.9	29.6	13	93.7	63.2	73	143.4	96.7	33	193.2	130.3	93	242.9	163.8
54	44.8	30.2	14	94.5	63.7	74	144.3	97.3	34	194.0	130.9	94	243.7	164.4
55	45.6	30.8	15	95.3	64.3	75	145.1	97.9	35	194.8	131.4	95	244.6	165.0
56	46.4	31.3	16	96.2	64.9	76	145.9	98.4	36	195.7	132.0	96	245.4	165.5
57	47.3	31.9	17	97.0	65.4	77	146.7	99.0	37	196.5	132.5	97	246.2	166.1
58	48.1	32.4	18	97.8	66.0	78	147.6	99.5	38	197.3	133.1	98	247.1	166.6
59	48.9	33.0	19	98.7	66.5	79	148.4	100.1	39	198.1	133.6	99	247.9	167.2
60	49.7	33.6	20	99.5	67.1	80	149.2	100.7	40	199.0	134.2	300	248.7	167.8

Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

[For 56 Degrees.

DIFFERENCE OF LATITUDE AND DEPARTURE FOR 35°.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	0.8	0.6	61	50.0	35.0	121	99.1	69.4	181	148.3	103.8	241	197.4	138.2
2	1.6	1.1	62	50.8	35.6	22	99.9	70.0	82	149.1	104.4	42	198.2	138.8
3	2.5	1.7	63	51.6	36.1	23	100.8	70.5	83	149.9	105.0	43	199.1	139.4
4	3.3	2.3	64	52.4	36.7	24	101.6	71.1	84	150.7	105.5	44	199.9	140.0
5	4.1	2.9	65	53.2	37.3	25	102.4	71.7	85	151.5	106.1	45	200.7	140.5
6	4.9	3.4	66	54.1	37.9	26	103.2	72.3	86	152.4	106.7	46	201.5	141.1
7	5.7	4.0	67	54.9	38.4	27	104.0	72.8	87	153.2	107.3	47	202.3	141.7
8	6.6	4.6	68	55.7	39.0	28	104.9	73.4	88	154.0	107.8	48	203.1	142.2
9	7.4	5.2	69	56.5	39.6	29	105.7	74.0	89	154.8	108.4	49	204.0	142.8
10	8.2	5.7	70	57.3	40.2	30	106.5	74.6	90	155.6	109.0	50	204.8	143.4
11	9.0	6.3	71	58.2	40.7	131	107.3	75.1	191	156.5	109.6	251	205.6	144.0
12	9.8	6.9	72	59.0	41.3	32	108.1	75.7	92	157.3	110.1	52	206.4	144.5
13	10.6	7.5	73	59.8	41.9	33	108.9	76.3	93	158.1	110.7	53	207.2	145.1
14	11.5	8.0	74	60.6	42.4	34	109.8	76.9	94	158.9	111.3	54	208.1	145.7
15	12.3	8.6	75	61.4	43.0	35	110.6	77.4	95	159.7	111.8	55	208.9	146.3
16	13.1	9.2	76	62.3	43.6	36	111.4	78.0	96	160.6	112.4	56	209.7	146.8
17	13.9	9.8	77	63.1	44.2	37	112.2	78.6	97	161.4	113.0	57	210.5	147.4
18	14.7	10.3	78	63.9	44.7	38	113.0	79.2	98	162.2	113.6	58	211.3	148.0
19	15.6	10.9	79	64.7	45.3	39	113.9	79.7	99	163.0	114.1	59	212.2	148.6
20	16.4	11.5	80	65.5	45.9	40	114.7	80.3	200	163.8	114.7	60	213.0	149.1
21	17.2	12.0	81	66.4	46.5	141	115.5	80.9	201	164.6	115.3	261	213.8	149.7
22	18.0	12.6	82	67.2	47.0	42	116.3	81.4	02	165.5	115.9	62	214.6	150.3
23	18.8	13.2	83	68.0	47.6	43	117.1	82.0	03	166.3	116.4	63	215.4	150.9
24	19.7	13.8	84	68.8	48.2	44	118.0	82.6	04	167.1	117.0	64	216.3	151.4
25	20.5	14.3	85	69.6	48.8	45	118.8	83.2	05	167.9	117.6	65	217.1	152.0
26	21.3	14.9	86	70.4	49.3	46	119.6	83.7	06	168.7	118.2	66	217.9	152.6
27	22.1	15.5	87	71.3	49.9	47	120.4	84.3	07	169.6	118.7	67	218.7	153.1
28	22.9	16.1	88	72.1	50.5	48	121.2	84.9	08	170.4	119.3	68	219.5	153.7
29	23.8	16.6	89	72.9	51.0	49	122.1	85.5	09	171.2	119.9	69	220.4	154.3
30	24.6	17.2	90	73.7	51.6	50	122.9	86.0	10	172.0	120.5	70	221.2	154.9
31	25.4	17.8	91	74.5	52.2	151	123.7	86.6	211	172.8	121.0	271	222.0	155.4
32	26.2	18.4	92	75.4	52.8	52	124.5	87.2	12	173.7	121.6	72	222.8	156.0
33	27.0	18.9	93	76.2	53.3	53	125.3	87.8	13	174.5	122.2	73	223.6	156.6
34	27.9	19.5	94	77.0	53.9	54	126.1	88.3	14	175.3	122.7	74	224.4	157.2
35	28.7	20.1	95	77.8	54.5	55	127.0	88.9	15	176.1	123.3	75	225.3	157.7
36	29.5	20.6	96	78.6	55.1	56	127.8	89.5	16	176.9	123.9	76	226.1	158.3
37	30.3	21.2	97	79.5	55.6	57	128.6	90.1	17	177.8	124.5	77	226.9	158.9
38	31.1	21.8	98	80.3	56.2	58	129.4	90.6	18	178.6	125.0	78	227.7	159.5
39	31.9	22.4	99	81.1	56.8	59	130.2	91.2	19	179.4	125.6	79	228.5	160.0
40	32.8	22.9	100	81.9	57.4	60	131.1	91.8	20	180.2	126.2	80	229.4	160.6
41	33.6	23.5	101	82.7	57.9	161	131.9	92.3	221	181.0	126.8	281	230.2	161.2
42	34.4	24.1	02	83.6	58.5	62	132.7	92.9	22	181.9	127.3	82	231.0	161.7
43	35.2	24.7	03	84.4	59.1	63	133.5	93.5	23	182.7	127.9	83	231.8	162.3
44	36.0	25.2	04	85.2	59.7	64	134.3	94.1	24	183.5	128.5	84	232.6	162.9
45	36.9	25.8	05	86.0	60.2	65	135.2	94.6	25	184.3	129.1	85	233.5	163.5
46	37.7	26.4	06	86.8	60.8	66	136.0	95.2	26	185.1	129.6	86	234.3	164.0
47	38.5	27.0	07	87.6	61.4	67	136.8	95.8	27	185.9	130.2	87	235.1	164.6
48	39.3	27.5	08	88.5	61.9	68	137.6	96.4	28	186.8	130.8	88	235.9	165.2
49	40.1	28.1	09	89.3	62.5	69	138.4	96.9	29	187.6	131.3	89	236.7	165.8
50	41.0	28.7	10	90.1	63.1	70	139.3	97.5	30	188.4	131.9	90	237.6	166.3
51	41.8	29.3	111	90.9	63.7	171	140.1	98.1	231	189.2	132.5	291	238.4	166.9
52	42.6	29.8	12	91.7	64.2	72	140.9	98.7	32	190.0	133.1	92	239.2	167.5
53	43.4	30.4	13	92.6	64.8	73	141.7	99.2	33	190.9	133.6	93	240.0	168.1
54	44.2	31.0	14	93.4	65.4	74	142.5	99.8	34	191.7	134.2	94	240.8	168.6
55	45.1	31.5	15	94.2	66.0	75	143.4	100.4	35	192.5	134.8	95	241.6	169.2
56	45.9	32.1	16	95.0	66.5	76	144.2	100.9	36	193.3	135.4	96	242.5	169.8
57	46.7	32.7	17	95.8	67.1	77	145.0	101.5	37	194.1	135.9	97	243.3	170.4
58	47.5	33.3	18	96.7	67.7	78	145.8	102.1	38	195.0	136.5	98	244.1	170.9
59	48.3	33.8	19	97.5	68.3	79	146.6	102.7	39	195.8	137.1	99	244.9	171.5
60	49.1	34.4	20	98.3	68.8	80	147.4	103.2	40	196.6	137.7	300	245.7	172.1

Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

[For 55 Degrees.

DIFFERENCE OF LATITUDE AND DEPARTURE FOR 36°.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	0.8	0.6	61	49.4	35.9	121	97.9	71.1	181	146.4	106.4	241	195.0	141.7
2	1.6	1.2	62	50.2	36.4	22	98.7	71.7	82	147.2	107.0	42	195.8	142.2
3	2.4	1.8	63	51.0	37.0	23	99.5	72.3	83	148.1	107.6	43	196.6	142.8
4	3.2	2.4	64	51.8	37.6	24	100.3	72.9	84	148.9	108.2	44	197.4	143.4
5	4.0	2.9	65	52.6	38.2	25	101.1	73.5	85	149.7	108.7	45	198.2	144.0
6	4.9	3.5	66	53.4	38.8	26	101.9	74.1	86	150.5	109.3	46	199.0	144.6
7	5.7	4.1	67	54.2	39.4	27	102.7	74.6	87	151.3	109.9	47	199.8	145.2
8	6.5	4.7	68	55.0	40.0	28	103.6	75.2	88	152.1	110.5	48	200.6	145.8
9	7.3	5.3	69	55.8	40.6	29	104.4	75.8	89	152.9	111.1	49	201.4	146.4
10	8.1	5.9	70	56.6	41.1	30	105.2	76.4	90	153.7	111.7	50	202.3	146.9
11	8.9	6.5	71	57.4	41.7	131	106.0	77.0	191	154.5	112.3	251	203.1	147.5
12	9.7	7.1	72	58.2	42.3	32	106.8	77.6	92	155.3	112.9	52	203.9	148.1
13	10.5	7.6	73	59.1	42.9	33	107.6	78.2	93	156.1	113.4	53	204.7	148.7
14	11.3	8.2	74	59.9	43.5	34	108.4	78.8	94	156.9	114.0	54	205.5	149.3
15	12.1	8.8	75	60.7	44.1	35	109.2	79.4	95	157.8	114.6	55	206.3	149.9
16	12.9	9.4	76	61.5	44.7	36	110.0	79.9	96	158.6	115.2	56	207.1	150.5
17	13.8	10.0	77	62.3	45.3	37	110.8	80.5	97	159.4	115.8	57	207.9	151.1
18	14.6	10.6	78	63.1	45.8	38	111.6	81.1	98	160.2	116.4	58	208.7	151.6
19	15.4	11.2	79	63.9	46.4	39	112.5	81.7	99	161.0	117.0	59	209.5	152.2
20	16.2	11.8	80	64.7	47.0	40	113.3	82.3	200	161.8	117.6	60	210.3	152.8
21	17.0	12.3	81	65.5	47.6	141	114.1	82.9	201	162.6	118.1	261	211.2	153.4
22	17.8	12.9	82	66.3	48.2	42	114.9	83.5	02	163.4	118.7	62	212.0	154.0
23	18.6	13.5	83	67.1	48.8	43	115.7	84.1	03	164.2	119.3	63	212.8	154.6
24	19.4	14.1	84	68.0	49.4	44	116.5	84.6	04	165.0	119.9	64	213.6	155.2
25	20.2	14.7	85	68.8	50.0	45	117.3	85.2	05	165.8	120.5	65	214.4	155.8
26	21.0	15.3	86	69.6	50.5	46	118.1	85.8	06	166.7	121.1	66	215.2	156.4
27	21.8	15.9	87	70.4	51.1	47	118.9	86.4	07	167.5	121.7	67	216.0	156.9
28	22.7	16.5	88	71.2	51.7	48	119.7	87.0	08	168.3	122.3	68	216.8	157.5
29	23.5	17.0	89	72.0	52.3	49	120.5	87.6	09	169.1	122.8	69	217.6	158.1
30	24.3	17.6	90	72.8	52.9	50	121.4	88.2	10	169.9	123.4	70	218.4	158.7
31	25.1	18.2	91	73.6	53.5	151	122.2	88.8	211	170.7	124.0	271	219.2	159.3
32	25.9	18.8	92	74.4	54.1	52	123.0	89.3	12	171.5	124.6	72	220.1	159.9
33	26.7	19.4	93	75.2	54.7	53	123.8	89.9	13	172.3	125.2	73	220.9	160.5
34	27.5	20.0	94	76.0	55.3	54	124.6	90.5	14	173.1	125.8	74	221.7	161.1
35	28.3	20.6	95	76.9	55.8	55	125.4	91.1	15	173.9	126.4	75	222.5	161.6
36	29.1	21.2	96	77.7	56.4	56	126.2	91.7	16	174.7	127.0	76	223.3	162.2
37	29.9	21.7	97	78.5	57.0	57	127.0	92.3	17	175.6	127.5	77	224.1	162.8
38	30.7	22.3	98	79.3	57.6	58	127.8	92.9	18	176.4	128.1	78	224.9	163.4
39	31.6	22.9	99	80.1	58.2	59	128.6	93.5	19	177.2	128.7	79	225.7	164.0
40	32.4	23.5	100	80.9	58.8	60	129.4	94.0	20	178.0	129.3	80	226.5	164.6
41	33.2	24.1	101	81.7	59.4	161	130.3	94.6	221	178.8	129.9	281	227.3	165.2
42	34.0	24.7	02	82.5	60.0	62	131.1	95.2	22	179.6	130.5	82	228.1	165.8
43	34.8	25.3	03	83.3	60.5	63	131.9	95.8	23	180.4	131.1	83	229.0	166.3
44	35.6	25.9	04	84.1	61.1	64	132.7	96.4	24	181.2	131.7	84	229.8	166.9
45	36.4	26.5	05	84.9	61.7	65	133.5	97.0	25	182.0	132.3	85	230.6	167.5
46	37.2	27.0	06	85.8	62.3	66	134.3	97.6	26	182.8	132.8	86	231.4	168.1
47	38.0	27.6	07	86.6	62.9	67	135.1	98.2	27	183.6	133.4	87	232.2	168.7
48	38.8	28.2	08	87.4	63.5	68	135.9	98.7	28	184.5	134.0	88	233.0	169.3
49	39.6	28.8	09	88.2	64.1	69	136.7	99.3	29	185.3	134.6	89	233.8	169.9
50	40.5	29.4	10	89.0	64.7	70	137.5	99.9	30	186.1	135.2	90	234.6	170.5
51	41.3	30.0	111	89.8	65.2	171	138.3	100.5	231	186.9	135.8	291	235.4	171.0
52	42.1	30.6	12	90.6	65.8	72	139.2	101.1	32	187.7	136.4	92	236.2	171.6
53	42.9	31.2	13	91.4	66.4	73	140.0	101.7	33	188.5	137.0	93	237.0	172.2
54	43.7	31.7	14	92.2	67.0	74	140.8	102.3	34	189.3	137.5	94	237.9	172.8
55	44.5	32.3	15	93.0	67.6	75	141.6	102.9	35	190.1	138.1	95	238.7	173.4
56	45.3	32.9	16	93.8	68.2	76	142.4	103.5	36	190.9	138.7	96	239.5	174.0
57	46.1	33.5	17	94.7	68.8	77	143.2	104.0	37	191.7	139.3	97	240.3	174.6
58	46.9	34.1	18	95.5	69.4	78	144.0	104.6	38	192.5	139.9	98	241.1	175.2
59	47.7	34.7	19	96.3	69.9	79	144.8	105.2	39	193.4	140.5	99	241.9	175.7
60	48.5	35.3	20	97.1	70.5	80	145.6	105.8	40	194.2	141.1	300	242.7	176.3

Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

[For 54 Degrees.

DIFFERENCE OF LATITUDE AND DEPARTURE FOR 37°.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	0.8	0.6	61	48.7	36.7	121	96.6	72.8	181	144.6	108.9	241	192.5	145.0
2	1.6	1.2	62	49.5	37.3	22	97.4	73.4	82	145.4	109.5	42	193.3	145.6
3	2.4	1.8	63	50.3	37.9	23	98.2	74.0	83	146.2	110.1	43	194.1	146.2
4	3.2	2.4	64	51.1	38.5	24	99.0	74.6	84	146.9	110.7	44	194.9	146.8
5	4.0	3.0	65	51.9	39.1	25	99.8	75.2	85	147.7	111.3	45	195.7	147.4
6	4.8	3.6	66	52.7	39.7	26	100.6	75.8	86	148.5	111.9	46	196.5	148.0
7	5.6	4.2	67	53.5	40.3	27	101.4	76.4	87	149.3	112.5	47	197.3	148.6
8	6.4	4.8	68	54.3	40.9	28	102.2	77.0	88	150.1	113.1	48	198.1	149.3
9	7.2	5.4	69	55.1	41.5	29	103.0	77.6	89	150.9	113.7	49	198.9	149.9
10	8.0	6.0	70	55.9	42.1	30	103.8	78.2	90	151.7	114.3	50	199.7	150.5
11	8.8	6.6	71	56.7	42.7	131	104.6	78.8	191	152.5	114.9	251	200.5	151.1
12	9.6	7.2	72	57.5	43.3	32	105.4	79.4	92	153.3	115.5	52	201.3	151.7
13	10.4	7.8	73	58.3	43.9	33	106.2	80.0	93	154.1	116.2	53	202.1	152.3
14	11.2	8.4	74	59.1	44.5	34	107.0	80.6	94	154.9	116.8	54	202.9	152.9
15	12.0	9.0	75	59.9	45.1	35	107.8	81.2	95	155.7	117.4	55	203.7	153.5
16	12.8	9.6	76	60.7	45.7	36	108.6	81.8	96	156.5	118.0	56	204.5	154.1
17	13.6	10.2	77	61.5	46.3	37	109.4	82.4	97	157.3	118.6	57	205.2	154.7
18	14.4	10.8	78	62.3	46.9	38	110.2	83.1	98	158.1	119.2	58	206.0	155.3
19	15.2	11.4	79	63.1	47.5	39	111.0	83.7	99	158.9	119.8	59	206.8	155.9
20	16.0	12.0	80	63.9	48.1	40	111.8	84.3	200	159.7	120.4	60	207.6	156.5
21	16.8	12.6	81	64.7	48.7	141	112.6	84.9	201	160.5	121.0	261	208.4	157.1
22	17.6	13.2	82	65.5	49.3	42	113.4	85.5	02	161.3	121.6	62	209.2	157.7
23	18.4	13.8	83	66.3	50.0	43	114.2	86.1	03	162.1	122.2	63	210.0	158.3
24	19.2	14.4	84	67.1	50.6	44	115.0	86.7	04	162.9	122.8	64	210.8	158.9
25	20.0	15.0	85	67.9	51.2	45	115.8	87.3	05	163.7	123.4	65	211.6	159.5
26	20.8	15.6	86	68.7	51.8	46	116.6	87.9	06	164.5	124.0	66	212.4	160.1
27	21.6	16.2	87	69.5	52.4	47	117.4	88.5	07	165.3	124.6	67	213.2	160.7
28	22.4	16.9	88	70.3	53.0	48	118.2	89.1	08	166.1	125.2	68	214.0	161.3
29	23.2	17.5	89	71.1	53.6	49	119.0	89.7	09	166.9	125.8	69	214.8	161.9
30	24.0	18.1	90	71.9	54.2	50	119.8	90.3	10	167.7	126.4	70	215.6	162.5
31	24.8	18.7	91	72.7	54.8	151	120.6	90.9	211	168.5	127.0	271	216.4	163.1
32	25.6	19.3	92	73.5	55.4	52	121.4	91.5	12	169.3	127.6	72	217.2	163.7
33	26.4	19.9	93	74.3	56.0	53	122.2	92.1	13	170.1	128.2	73	218.0	164.3
34	27.2	20.5	94	75.1	56.6	54	123.0	92.7	14	170.9	128.8	74	218.8	164.9
35	28.0	21.1	95	75.9	57.2	55	123.8	93.3	15	171.7	129.4	75	219.6	165.5
36	28.8	21.7	96	76.7	57.8	56	124.6	93.9	16	172.5	130.0	76	220.4	166.1
37	29.5	22.3	97	77.5	58.4	57	125.4	94.5	17	173.3	130.6	77	221.2	166.7
38	30.3	22.9	98	78.3	59.0	58	126.2	95.1	18	174.1	131.2	78	222.0	167.3
39	31.1	23.5	99	79.1	59.6	59	127.0	95.7	19	174.9	131.8	79	222.8	167.9
40	31.9	24.1	100	79.9	60.2	60	127.8	96.3	20	175.7	132.4	80	223.6	168.5
41	32.7	24.7	101	80.7	60.8	161	128.6	96.9	221	176.5	133.0	281	224.4	169.1
42	33.5	25.3	02	81.5	61.4	62	129.4	97.5	22	177.3	133.6	82	225.2	169.7
43	34.3	25.9	03	82.3	62.0	63	130.2	98.1	23	178.1	134.2	83	226.0	170.3
44	35.1	26.5	04	83.1	62.6	64	131.0	98.7	24	178.9	134.8	84	226.8	170.9
45	35.9	27.1	05	83.9	63.2	65	131.8	99.3	25	179.7	135.4	85	227.6	171.5
46	36.7	27.7	06	84.7	63.8	66	132.6	99.9	26	180.5	136.0	86	228.4	172.1
47	37.5	28.3	07	85.5	64.4	67	133.4	100.5	27	181.3	136.6	87	229.2	172.7
48	38.3	28.9	08	86.3	65.0	68	134.2	101.1	28	182.1	137.2	88	230.0	173.3
49	39.1	29.5	09	87.1	65.6	69	135.0	101.7	29	182.9	137.8	89	230.8	173.9
50	39.9	30.1	10	87.8	66.2	70	135.8	102.3	30	183.7	138.4	90	231.6	174.5
51	40.7	30.7	111	88.6	66.8	171	136.6	102.9	231	184.5	139.0	291	232.4	175.1
52	41.5	31.3	12	89.4	67.4	72	137.4	103.5	32	185.3	139.6	92	233.2	175.7
53	42.3	31.9	13	90.2	68.0	73	138.2	104.1	33	186.1	140.2	93	234.0	176.3
54	43.1	32.5	14	91.0	68.6	74	139.0	104.7	34	186.9	140.8	94	234.8	176.9
55	43.9	33.1	15	91.8	69.2	75	139.8	105.3	35	187.7	141.4	95	235.6	177.5
56	44.7	33.7	16	92.6	69.8	76	140.6	105.9	36	188.5	142.0	96	236.4	178.1
57	45.5	34.3	17	93.4	70.4	77	141.4	106.5	37	189.3	142.6	97	237.2	178.7
58	46.3	34.9	18	94.2	71.0	78	142.2	107.1	38	190.1	143.2	98	238.0	179.3
59	47.1	35.5	19	95.0	71.6	79	143.0	107.7	39	190.9	143.8	99	238.8	179.9
60	47.9	36.1	20	95.8	72.2	80	143.8	108.3	40	191.7	144.4	300	239.6	180.5

Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

[For 53 Degrees.

DIFFERENCE OF LATITUDE AND DEPARTURE FOR 38°.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	0.8	0.6	61	48.1	37.6	121	95.3	74.5	181	142.6	111.4	241	189.9	148.4
2	1.6	1.2	62	48.9	38.2	22	96.1	75.1	82	143.4	112.1	42	190.7	149.0
3	2.4	1.8	63	49.6	38.8	23	96.9	75.7	83	144.2	112.7	43	191.5	149.6
4	3.2	2.5	64	50.4	39.4	24	97.7	76.3	84	145.0	113.3	44	192.3	150.2
5	3.9	3.1	65	51.2	40.0	25	98.5	77.0	85	145.8	113.9	45	193.1	150.8
6	4.7	3.7	66	52.0	40.6	26	99.3	77.6	86	146.6	114.5	46	193.9	151.5
7	5.5	4.3	67	52.8	41.2	27	100.1	78.2	87	147.4	115.1	47	194.6	152.1
8	6.3	4.9	68	53.6	41.9	28	100.9	78.8	88	148.1	115.7	48	195.4	152.7
9	7.1	5.5	69	54.4	42.5	29	101.7	79.4	89	148.9	116.4	49	196.2	153.3
10	7.9	6.2	70	55.2	43.1	30	102.4	80.0	90	149.7	117.0	50	197.0	153.9
11	8.7	6.8	71	55.9	43.7	131	103.2	80.7	191	150.5	117.6	251	197.8	154.5
12	9.5	7.4	72	56.7	44.3	32	104.0	81.3	92	151.3	118.2	52	198.6	155.1
13	10.2	8.0	73	57.5	44.9	33	104.8	81.9	93	152.1	118.8	53	199.4	155.8
14	11.0	8.6	74	58.3	45.6	34	105.6	82.5	94	152.9	119.4	54	200.2	156.4
15	11.8	9.2	75	59.1	46.2	35	106.4	83.1	95	153.7	120.1	55	200.9	157.0
16	12.6	9.9	76	59.9	46.8	36	107.2	83.7	96	154.5	120.7	56	201.7	157.6
17	13.4	10.5	77	60.7	47.4	37	108.0	84.3	97	155.2	121.3	57	202.5	158.2
18	14.2	11.1	78	61.5	48.0	38	108.7	85.0	98	156.0	121.9	58	203.3	158.8
19	15.0	11.7	79	62.3	48.6	39	109.5	85.6	99	156.8	122.5	59	204.1	159.5
20	15.8	12.3	80	63.0	49.3	40	110.3	86.2	200	157.6	123.1	60	204.9	160.1
21	16.5	12.9	81	63.8	49.9	141	111.1	86.8	201	158.4	123.7	261	205.7	160.7
22	17.3	13.5	82	64.6	50.5	42	111.9	87.4	02	159.2	124.4	62	206.5	161.3
23	18.1	14.2	83	65.4	51.1	43	112.7	88.0	03	160.0	125.0	63	207.2	161.9
24	18.9	14.8	84	66.2	51.7	44	113.5	88.7	04	160.8	125.6	64	208.0	162.5
25	19.7	15.4	85	67.0	52.3	45	114.3	89.3	05	161.5	126.2	65	208.8	163.2
26	20.5	16.0	86	67.8	52.9	46	115.0	89.9	06	162.3	126.8	66	209.6	163.8
27	21.3	16.6	87	68.6	53.6	47	115.8	90.5	07	163.1	127.4	67	210.4	164.4
28	22.1	17.2	88	69.3	54.2	48	116.6	91.1	08	163.9	128.1	68	211.2	165.0
29	22.9	17.9	89	70.1	54.8	49	117.4	91.7	09	164.7	128.7	69	212.0	165.6
30	23.6	18.5	90	70.9	55.4	50	118.2	92.3	10	165.5	129.3	70	212.8	166.2
31	24.4	19.1	91	71.7	56.0	151	119.0	93.0	211	166.3	129.9	271	213.6	166.8
32	25.2	19.7	92	72.5	56.6	52	119.8	93.6	12	167.1	130.5	72	214.3	167.5
33	26.0	20.3	93	73.3	57.3	53	120.6	94.2	13	167.8	131.1	73	215.1	168.1
34	26.8	20.9	94	74.1	57.9	54	121.4	94.8	14	168.6	131.8	74	215.9	168.7
35	27.6	21.5	95	74.9	58.5	55	122.1	95.4	15	169.4	132.4	75	216.7	169.3
36	28.4	22.2	96	75.6	59.1	56	122.9	96.0	16	170.2	133.0	76	217.5	169.9
37	29.2	22.8	97	76.4	59.7	57	123.7	96.7	17	171.0	133.6	77	218.3	170.5
38	29.9	23.4	98	77.2	60.3	58	124.5	97.3	18	171.8	134.2	78	219.1	171.2
39	30.7	24.0	99	78.0	61.0	59	125.3	97.9	19	172.6	134.8	79	219.9	171.8
40	31.5	24.6	100	78.8	61.6	60	126.1	98.5	20	173.4	135.4	80	220.6	172.4
41	32.3	25.2	101	79.6	62.2	161	126.9	99.1	221	174.2	136.1	281	221.4	173.0
42	33.1	25.9	02	80.4	62.8	62	127.7	99.7	22	174.9	136.7	82	222.2	173.6
43	33.9	26.5	03	81.2	63.4	63	128.4	100.4	23	175.7	137.3	83	223.0	174.2
44	34.7	27.1	04	82.0	64.0	64	129.2	101.0	24	176.5	137.9	84	223.8	174.8
45	35.5	27.7	05	82.7	64.6	65	130.0	101.6	25	177.3	138.5	85	224.6	175.5
46	36.2	28.3	06	83.5	65.3	66	130.8	102.2	26	178.1	139.1	86	225.4	176.1
47	37.0	28.9	07	84.3	65.9	67	131.6	102.8	27	178.9	139.8	87	226.2	176.7
48	37.8	29.6	08	85.1	66.5	68	132.4	103.4	28	179.7	140.4	88	226.9	177.3
49	38.6	30.2	09	85.9	67.1	69	133.2	104.0	29	180.5	141.0	89	227.7	177.9
50	39.4	30.8	10	86.7	67.7	70	134.0	104.7	30	181.2	141.6	90	228.5	178.5
51	40.2	31.4	111	87.5	68.3	171	134.7	105.3	231	182.0	142.2	291	229.3	179.2
52	41.0	32.0	12	88.3	69.0	72	135.5	105.9	32	182.8	142.8	92	230.1	179.8
53	41.8	32.6	13	89.0	69.6	73	136.3	106.5	33	183.6	143.4	93	230.9	180.4
54	42.6	33.2	14	89.8	70.2	74	137.1	107.1	34	184.4	144.1	94	231.7	181.0
55	43.3	33.9	15	90.6	70.8	75	137.9	107.7	35	185.2	144.7	95	232.5	181.6
56	44.1	34.5	16	91.4	71.4	76	138.7	108.4	36	186.0	145.3	96	233.3	182.2
57	44.9	35.1	17	92.2	72.0	77	139.5	109.0	37	186.8	145.9	97	234.1	182.9
58	45.7	35.7	18	93.0	72.6	78	140.3	109.6	38	187.5	146.5	98	234.8	183.5
59	46.5	36.3	19	93.8	73.3	79	141.1	110.2	39	188.3	147.1	99	235.6	184.1
60	47.3	36.9	20	94.6	73.9	80	141.8	110.8	40	189.1	147.8	300	236.4	184.7

Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat

[For 52 Degrees.

DIFFERENCE OF LATITUDE AND DEPARTURE FOR 39°.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep	Dist.	Lat	Dep
1	0. 8	0. 6	61	47. 4	38. 4	121	94. 0	76. 1	181	140. 7	113. 9	241	187. 3	151. 7
2	1. 6	1. 3	62	48. 2	39. 0	22	94. 8	76. 8	82	141. 4	114. 5	42	188. 1	152. 3
3	2. 3	1. 9	63	49. 0	39. 6	23	95. 6	77. 4	83	142. 2	115. 2	43	188. 8	152. 9
4	3. 1	2. 5	64	49. 7	40. 3	24	96. 4	78. 0	84	143. 0	115. 8	44	189. 6	153. 6
5	3. 9	3. 1	65	50. 5	40. 9	25	97. 1	78. 7	85	143. 8	116. 4	45	190. 4	154. 2
6	4. 7	3. 8	66	51. 3	41. 5	26	97. 9	79. 3	86	144. 5	117. 1	46	191. 2	154. 8
7	5. 4	4. 4	67	52. 1	42. 2	27	98. 7	79. 9	87	145. 3	117. 7	47	192. 0	155. 4
8	6. 2	5. 0	68	52. 8	42. 8	28	99. 5	80. 6	88	146. 1	118. 3	48	192. 7	156. 1
9	7. 0	5. 7	69	53. 6	43. 4	29	100. 3	81. 2	89	146. 9	118. 9	49	193 5	156. 7
10	7. 8	6. 3	70	54. 4	44. 1	30	101. 0	81. 8	90	147. 7	119. 6	50	194. 3	157. 3
11	8. 5	6. 9	71	55. 2	44. 7	131	101. 8	82. 4	191	148. 4	120. 2	251	195. 1	158. 0
12	9. 3	7. 6	72	56. 0	45. 3	32	102. 6	83. 1	92	149. 2	120. 8	52	195. 8	158. 6
13	10. 1	8. 2	73	56. 7	45. 9	33	103. 4	83. 7	93	150. 0	121. 5	53	196. 6	159. 2
14	10. 9	8. 8	74	57. 5	46. 6	34	104. 1	84. 3	94	150. 8	122. 1	54	197. 4	159. 8
15	11. 7	9. 4	75	58. 3	47. 2	35	104. 9	85. 0	95	151. 5	122. 7	55	198. 2	160. 5
16	12. 4	10. 1	76	59. 1	47. 8	36	105. 7	85. 6	96	152. 3	123. 3	56	198. 9	161. 1
17	13. 2	10. 7	77	59. 8	48. 5	37	106. 5	86. 2	97	153. 1	124. 0	57	199. 7	161. 7
18	14. 0	11. 3	78	60. 6	49. 1	38	107. 2	86. 8	98	153. 9	124. 6	58	200. 5	162. 4
19	14. 8	12. 0	79	61. 4	49. 7	39	108. 0	87. 5	99	154. 7	125. 2	59	201. 3	163. 0
20	15. 5	12. 6	80	62. 2	50. 3	40	108. 8	88. 1	200	155. 4	125. 9	60	202. 1	163. 6
21	16. 3	13. 2	81	62. 9	51. 0	141	109. 6	88. 7	201	156. 2	126. 5	261	202. 8	164. 3
22	17. 1	13. 8	82	63. 7	51. 6	42	110. 4	89. 4	02	157. 0	127. 1	62	203. 6	164. 9
23	17. 9	14. 5	83	64. 5	52. 2	43	111. 1	90. 0	03	157. 8	127. 8	63	204. 4	165. 5
24	18. 7	15. 1	84	65. 3	52. 9	44	111. 9	90. 6	04	158. 5	128. 4	64	205. 2	166. 1
25	19. 4	15. 7	85	66. 1	53 5	45	112. 7	91. 3	05	159. 3	129. 0	65	205. 9	166. 8
26	20. 2	16. 4	86	65. 8	54. 1	46	113. 5	91. 9	06	160. 1	129. 6	66	206. 7	167. 4
27	21. 0	17. 0	87	67. 6	54. 8	47	114. 2	92. 5	07	160. 9	130. 3	67	207. 5	168. 0
28	21. 8	17. 6	88	68. 4	55. 4	48	115. 0	93. 1	08	161. 6	130. 9	68	208. 3	168. 7
29	22. 5	18. 3	89	69. 2	56. 0	49	115. 8	93. 8	09	162. 4	131. 5	69	209. 1	169. 3
30	23. 3	18. 9	90	69. 9	56. 6	50	116. 6	94. 4	10	163. 2	132. 2	70	209. 8	169. 9
31	24. 1	19. 5	91	70. 7	57. 3	151	117. 3	95. 0	211	164. 0	132. 8	271	210. 6	170. 5
32	24. 9	20. 1	92	71. 5	57. 9	52	118. 1	95. 7	12	164. 8	133. 4	72	211. 4	171. 2
33	25. 6	20. 8	93	72. 3	58. 5	53	118. 9	96. 3	13	165. 5	134. 0	73	212. 2	171. 8
34	26. 4	21. 4	94	73. 1	59. 2	54	119. 7	96. 9	14	166. 3	134. 7	74	212. 9	172. 4
35	27. 2	22. 0	95	73. 8	59. 8	55	120. 5	97. 5	15	167. 1	135. 3	75	213. 7	173. 1
36	28. 0	22. 7	96	74. 6	60. 4	56	121. 2	98. 2	16	167. 9	135. 9	76	214. 5	173. 7
37	28. 8	23. 3	97	75. 4	61. 0	57	122. 0	98. 8	17	168. 6	136. 6	77	215. 3	174. 3
38	29. 5	23. 9	98	76. 2	61. 7	58	122. 8	99. 4	18	169. 4	137. 2	78	216. 0	175. 0
39	30. 3	24. 5	99	76. 9	62. 3	59	123. 6	100. 1	19	170. 2	137. 8	79	216. 8	175. 6
40	31. 1	25. 2	100	77. 7	62. 9	60	124. 3	100. 7	20	171. 0	138. 5	80	217. 6	176. 2
41	31. 9	25. 8	101	78. 5	63. 6	161	125. 1	101. 3	221	171. 7	139. 1	281	218. 4	176. 8
42	32. 6	26. 4	02	79. 3	64. 2	62	125. 9	101. 9	22	172. 5	139. 7	82	219. 2	177. 5
43	33. 4	27. 1	03	80. 0	64. 8	63	126. 7	102. 6	23	173. 3	140. 3	83	219. 9	178. 1
44	34. 2	27. 7	04	80. 8	65. 4	64	127. 5	103. 2	24	174. 1	141. 0	84	220. 7	178. 7
45	35. 0	28. 3	05	81. 6	66. 1	65	128. 2	103. 8	25	174. 9	141. 6	85	221. 5	179. 4
46	35. 7	28. 9	06	82. 4	66. 7	66	129. 0	104. 5	26	175. 6	142. 2	86	222. 3	180. 0
47	36. 5	29. 6	07	83. 2	67. 3	67	129. 8	105. 1	27	176. 4	142. 9	87	223. 0	180. 6
48	37. 3	30. 2	08	83. 9	68. 0	68	130. 6	105. 7	28	177. 2	143. 5	88	223. 8	181. 2
49	38. 1	30. 8	09	84. 7	68. 6	69	131. 3	106. 4	29	178. 0	144. 1	89	224. 6	181. 9
50	38. 9	31. 5	10	85. 5	69. 2	70	132. 1	107. 0	30	178. 7	144. 7	90	225. 4	182. 5
51	39. 6	32. 1	111	86. 3	69. 9	171	132. 9	107. 6	231	179. 5	145. 4	291	226. 1	183. 1
52	40. 4	32. 7	12	87. 0	70. 5	72	133. 7	108. 2	32	180. 3	146. 0	92	226. 9	183. 8
53	41. 2	33. 4	13	87. 8	71. 1	73	134. 4	108. 9	33	181. 1	146. 6	93	227. 7	184. 4
54	42. 0	34. 0	14	88. 6	71. 7	74	135. 2	109. 5	34	181. 9	147. 3	94	228. 5	185. 0
55	42. 7	34. 6	15	89. 4	72. 4	75	136. 0	110. 1	35	182. 6	147. 9	95	229. 3	185. 6
56	43. 5	35. 2	16	90. 1	73. 0	76	136. 8	110. 8	36	183. 4	148. 5	96	230. 0	186. 3
57	44. 3	35. 9	17	90. 9	73. 6	77	137. 6	111. 4	37	184. 2	149. 1	97	230. 8	186. 9
58	45. 1	36. 5	18	91. 7	74. 3	78	138. 3	112. 0	38	185. 0	149. 8	98	231. 6	187. 5
59	45. 9	37. 1	19	92. 5	74. 9	79	139. 1	112. 6	39	185. 7	150. 4	99	232. 4	188. 2
60	46. 6	37. 8	20	93. 3	75. 5	80	139. 9	113. 3	40	186. 5	151. 0	300	233. 1	188. 8

Dist.	Dep.	Lat.	Dist	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat
													[For 51 Degrees.	

DIFFERENCE OF LATITUDE AND DEPARTURE FOR 40°.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	0.8	0.6	61	46.7	39.2	121	92.7	77.8	181	138.7	116.3	241	184.6	154.9
2	1.5	1.3	62	47.5	39.9	22	93.5	78.4	82	139.4	117.0	42	185.4	155.6
3	2.3	1.9	63	48.3	40.5	23	94.2	79.1	83	140.2	117.6	43	186.1	156.2
4	3.1	2.6	64	49.0	41.1	24	95.0	79.7	84	141.0	118.3	44	186.9	156.8
5	3.8	3.2	65	49.8	41.8	25	95.8	80.3	85	141.7	118.9	45	187.7	157.5
6	4.6	3.9	66	50.6	42.4	26	96.5	81.0	86	142.5	119.6	46	188.4	158.1
7	5.4	4.5	67	51.3	43.1	27	97.3	81.6	87	143.3	120.2	47	189.2	158.8
8	6.1	5.1	68	52.1	43.7	28	98.1	82.3	88	144.0	120.8	48	190.0	159.4
9	6.9	5.8	69	52.9	44.4	29	98.8	82.9	89	144.8	121.5	49	190.7	160.1
10	7.7	6.4	70	53.6	45.0	30	99.6	83.6	90	145.5	122.1	50	191.5	160.7
11	8.4	7.1	71	54.4	45.6	131	100.4	84.2	191	146.3	122.8	251	192.3	161.3
12	9.2	7.7	72	55.2	46.3	32	101.1	84.8	92	147.1	123.4	52	193.0	162.0
13	10.0	8.4	73	55.9	46.9	33	101.9	85.5	93	147.8	124.1	53	193.8	162.6
14	10.7	9.0	74	56.7	47.6	34	102.6	86.1	94	148.6	124.7	54	194.6	163.3
15	11.5	9.6	75	57.5	48.2	35	103.4	86.8	95	149.4	125.3	55	195.3	163.9
16	12.3	10.3	76	58.2	48.9	36	104.2	87.4	96	150.1	126.0	56	196.1	164.6
17	13.0	10.9	77	59.0	49.5	37	104.9	88.1	97	150.9	126.6	57	196.9	165.2
18	13.8	11.6	78	59.8	50.1	38	105.7	88.7	98	151.7	127.3	58	197.6	165.8
19	14.6	12.2	79	60.5	50.8	39	106.5	89.3	99	152.4	127.9	59	198.4	166.5
20	15.3	12.9	80	61.3	51.4	40	107.2	90.0	200	153.2	128.6	60	199.2	167.1
21	16.1	13.5	81	62.0	52.1	141	108.0	90.6	201	154.0	129.2	261	199.9	167.8
22	16.9	14.1	82	62.8	52.7	42	108.8	91.3	02	154.7	129.8	62	200.7	168.4
23	17.6	14.8	83	63.6	53.4	43	109.5	91.9	03	155.5	130.5	63	201.5	169.1
24	18.4	15.4	84	64.3	54.0	44	110.3	92.6	04	156.3	131.1	64	202.2	169.7
25	19.2	16.1	85	65.1	54.6	45	111.1	93.2	05	157.0	131.8	65	203.0	170.3
26	19.9	16.7	86	65.9	55.3	46	111.8	93.8	06	157.8	132.4	66	203.8	171.0
27	20.7	17.4	87	66.6	55.9	47	112.6	94.5	07	158.6	133.1	67	204.5	171.6
28	21.4	18.0	88	67.4	56.6	48	113.4	95.1	08	159.3	133.7	68	205.3	172.3
29	22.2	18.6	89	68.2	57.2	49	114.1	95.8	09	160.1	134.3	69	206.1	172.9
30	23.0	19.3	90	68.9	57.9	50	114.9	96.4	10	160.9	135.0	70	206.8	173.6
31	23.7	19.9	91	69.7	58.5	151	115.7	97.1	211	161.6	135.6	271	207.6	174.2
32	24.5	20.6	92	70.5	59.1	52	116.4	97.7	12	162.4	136.3	72	208.4	174.8
33	25.3	21.2	93	71.2	59.8	53	117.2	98.3	13	163.2	136.9	73	209.1	175.5
34	26.0	21.9	94	72.0	60.4	54	118.0	99.0	14	163.9	137.6	74	209.9	176.1
35	26.8	22.5	95	72.8	61.1	55	118.7	99.6	15	164.7	138.2	75	210.7	176.8
36	27.6	23.1	96	73.5	61.7	56	119.5	100.3	16	163.5	138.8	76	211.4	177.4
37	28.3	23.8	97	74.3	62.4	57	120.3	100.9	17	166.2	139.5	77	212.2	178.1
38	29.1	24.4	98	75.1	63.0	58	121.0	101.6	18	167.0	140.1	78	213.0	178.7
39	29.9	25.1	99	75.8	63.6	59	121.8	102.2	19	167.8	140.8	79	213.7	179.3
40	30.6	25.7	100	76.6	64.3	60	122.6	102.8	20	168.5	141.4	80	214.5	180.0
41	31.4	26.4	101	77.4	64.9	161	123.3	103.5	221	169.3	142.1	281	215.3	180.6
42	32.2	27.0	02	78.1	65.6	62	124.1	104.1	22	170.1	142.7	82	216.0	181.3
43	32.9	27.6	03	78.9	66.2	63	124.9	104.8	23	170.8	143.3	83	216.8	181.9
44	33.7	28.3	04	79.7	66.8	64	125.6	105.4	24	171.6	144.0	84	217.6	182.6
45	34.5	28.9	05	80.4	67.5	65	126.4	106.1	25	172.4	144.6	85	218.3	183.2
46	35.2	29.6	06	81.2	68.1	66	127.2	106.7	26	173.1	145.3	86	219.1	183.8
47	36.0	30.2	07	82.0	68.8	67	127.9	107.3	27	173.9	145.9	87	219.9	184.5
48	36.8	30.9	08	82.7	69.4	68	128.7	108.0	28	174.7	146.6	88	220.6	185.1
49	37.5	31.5	09	83.5	70.1	69	129.5	108.6	29	175.4	147.2	89	221.4	185.8
50	38.3	32.1	10	84.3	70.7	70	130.2	109.3	30	176.2	147.8	90	222.2	186.4
51	39.1	32.8	111	85.0	71.3	171	131.0	109.9	231	177.0	148.5	291	222.9	187.1
52	39.8	33.4	12	85.8	72.0	72	131.8	110.6	32	177.7	149.1	92	223.7	187.7
53	40.6	34.1	13	86.6	72.6	73	132.5	111.2	33	178.5	149.8	93	224.5	188.3
54	41.4	34.7	14	87.3	73.3	74	133.3	111.8	34	179.3	150.4	94	225.2	189.0
55	42.1	35.4	15	88.1	73.9	75	134.1	112.5	35	180.0	151.1	95	226.0	189.6
56	42.9	36.0	16	88.9	74.6	76	134.8	113.1	36	180.8	151.7	96	226.7	190.3
57	43.7	36.6	17	89.6	75.2	77	135.6	113.8	37	181.6	152.3	97	227.5	190.9
58	44.4	37.3	18	90.4	75.8	78	136.4	114.4	38	182.3	153.0	98	228.3	191.6
59	45.2	37.9	19	91.2	76.5	79	137.1	115.1	39	183.1	153.6	99	229.0	192.2
60	46.0	38.6	20	91.9	77.1	80	137.9	115.7	40	183.9	154.3	300	229.8	192.8

Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

[For 50 Degrees.

DIFFERENCE OF LATITUDE AND DEPARTURE FOR 41°.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	0.8	0.7	61	46.0	40.0	121	91.3	79.4	181	136.6	118.7	241	181.9	158.1
2	1.5	1.3	62	46.8	40.7	22	92.1	80.0	82	137.4	119.4	42	182.6	158.8
3	2.3	2.0	63	47.5	41.3	23	92.8	80.7	83	138.1	120.1	43	183.4	159.4
4	3.0	2.6	64	48.3	42.0	24	93.6	81.4	84	138.9	120.7	44	184.1	160.1
5	3.8	3.3	65	49.1	42.6	25	94.3	82.0	85	139.6	121.4	45	184.9	160.7
6	4.5	3.9	66	49.8	43.3	26	95.1	82.7	86	140.4	122.0	46	185.7	161.4
7	5.3	4.6	67	50.6	44.0	27	95.8	83.3	87	141.1	122.7	47	186.4	162.0
8	6.0	5.2	68	51.3	44.6	28	96.6	84.0	88	141.9	123.3	48	187.2	162.7
9	6.8	5.9	69	52.1	45.3	29	97.4	84.6	89	142.6	124.0	49	187.9	163.4
10	7.5	6.6	70	52.8	45.9	30	98.1	85.3	90	143.4	124.7	50	188.7	164.0
11	8.3	7.2	71	53.6	46.6	131	98.9	85.9	191	144.1	125.3	251	189.4	164.7
12	9.1	7.9	72	54.3	47.2	32	99.6	86.6	92	144.9	126.0	52	190.2	165.3
13	9.8	8.5	73	55.1	47.9	33	100.4	87.3	93	145.7	126.6	53	190.9	166.0
14	10.6	9.2	74	55.8	48.5	34	101.1	87.9	94	146.4	127.3	54	191.7	166.6
15	11.3	9.8	75	56.6	49.2	35	101.9	88.6	95	147.2	127.9	55	192.5	167.3
16	12.1	10.5	76	57.4	49.9	36	102.6	89.2	96	147.9	128.6	56	193.2	168.0
17	12.8	11.2	77	58.1	50.5	37	103.4	89.9	97	148.7	129.2	57	194.0	168.6
18	13.6	11.8	78	58.9	51.2	38	104.1	90.5	98	149.4	129.9	58	194.7	169.3
19	14.3	12.5	79	59.6	51.8	39	104.9	91.2	99	150.2	130.6	59	195.5	169.9
20	15.1	13.1	80	60.4	52.5	40	105.7	91.8	200	150.9	131.2	60	196.2	170.6
21	15.8	13.8	81	61.1	53.1	141	106.4	92.5	201	151.7	131.9	261	197.0	171.2
22	16.6	14.4	82	61.9	53.8	42	107.2	93.2	02	152.5	132.5	62	197.7	171.9
23	17.4	15.1	83	62.6	54.5	43	107.9	93.8	03	153.2	133.2	63	198.5	172.5
24	18.1	15.7	84	63.4	55.1	44	108.7	94.5	04	154.0	133.8	64	199.2	173.2
25	18.9	16.4	85	64.2	55.8	45	109.4	95.1	05	154.7	134.5	65	200.0	173.9
26	19.6	17.1	86	64.9	56.4	46	110.2	95.8	06	155.5	135.1	66	200.8	174.5
27	20.4	17.7	87	65.7	57.1	47	110.9	96.4	07	156.2	135.8	67	201.5	175.2
28	21.1	18.4	88	66.4	57.7	48	111.7	97.1	08	157.0	136.5	68	202.3	175.8
29	21.9	19.0	89	67.2	58.4	49	112.5	97.8	09	157.7	137.1	69	203.0	176.5
30	22.6	19.7	90	67.9	59.0	50	113.2	98.4	10	158.5	137.8	70	203.8	177.1
31	23.4	20.3	91	68.7	59.7	151	114.0	99.1	211	159.2	138.4	271	204.5	177.8
32	24.2	21.0	92	69.4	60.4	52	114.7	99.7	12	160.0	139.1	72	205.3	178.4
33	24.9	21.6	93	70.2	61.0	53	115.5	100.4	13	160.8	139.7	73	206.0	179.1
34	25.7	22.3	94	70.9	61.7	54	116.2	101.0	14	161.5	140.4	74	206.8	179.8
35	26.4	23.0	95	71.7	62.3	55	117.0	101.7	15	162.3	141.1	75	207.5	180.4
36	27.2	23.6	96	72.5	63.0	56	117.7	102.3	16	163.0	141.7	76	208.3	181.1
37	27.9	24.3	97	73.2	63.6	57	118.5	103.0	17	163.8	142.4	77	209.1	181.7
38	28.7	24.9	98	74.0	64.3	58	119.2	103.7	18	164.5	143.0	78	209.8	182.4
39	29.4	25.6	99	74.7	64.9	59	120.0	104.3	19	165.3	143.7	79	210.6	183.0
40	30.2	26.2	200	75.5	65.6	60	120.8	105.0	20	166.0	144.3	80	211.3	183.7
41	30.9	26.9	101	76.2	66.3	161	121.5	105.6	221	166.8	145.0	281	212.1	184.4
42	31.7	27.6	02	77.0	66.9	62	122.3	106.3	22	167.5	145.6	82	212.8	185.0
43	32.5	28.2	03	77.7	67.6	63	123.0	106.9	23	168.3	146.3	83	213.6	185.7
44	33.2	28.9	04	78.5	68.2	64	123.8	107.6	24	169.1	147.0	84	214.3	186.3
45	34.0	29.5	05	79.2	68.9	65	124.5	108.2	25	169.8	147.6	85	215.1	187.0
46	34.7	30.2	06	80.0	69.5	66	125.3	108.9	26	170.6	148.3	86	215.8	187.6
47	35.5	30.8	07	80.8	70.2	67	126.0	109.6	27	171.3	148.9	87	216.6	188.3
48	36.2	31.5	08	81.5	70.9	68	126.8	110.2	28	172.1	149.6	88	217.4	188.9
49	37.0	32.1	09	82.3	71.5	69	127.5	110.9	29	172.8	150.2	89	218.1	189.6
50	37.7	32.8	10	83.0	72.2	70	128.3	111.5	30	173.6	150.9	90	218.9	190.3
51	38.5	33.5	111	83.8	72.8	171	129.1	112.2	231	174.3	151.5	291	219.6	190.9
52	39.2	34.1	12	84.5	73.5	72	129.8	112.8	32	175.1	152.2	92	220.4	191.6
53	40.0	34.8	13	85.3	74.1	73	130.6	113.5	33	175.8	152.9	93	221.1	192.2
54	40.8	35.4	14	86.0	74.8	74	131.3	114.2	34	176.6	153.5	94	221.9	192.9
55	41.5	36.1	15	86.8	75.4	75	132.1	114.8	35	177.4	154.2	95	222.6	193.5
56	42.3	36.7	16	87.5	76.1	76	132.8	115.5	36	178.1	154.8	96	223.4	194.2
57	43.0	37.4	17	88.3	76.8	77	133.6	116.1	37	178.9	155.5	97	224.1	194.8
58	43.8	38.1	18	89.1	77.4	78	134.3	116.8	38	179.6	156.1	98	224.9	195.5
59	44.5	38.7	19	89.8	78.1	79	135.1	117.4	39	180.4	156.8	99	225.7	196.2
60	45.3	39.4	20	90.6	78.7	80	135.8	118.1	40	181.1	157.5	300	226.4	196.8

Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

[For 49 Degrees.

DIFFERENCE OF LATITUDE AND DEPARTURE FOR 42°

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	0. 7	0. 7	61	45. 3	40. 8	121	89. 9	81. 0	181	134. 5	121. 1	241	179. 1	161. 3
2	1. 5	1. 3	62	46. 1	41. 5	22	90. 7	81. 6	82	135. 3	121. 8	42	179. 8	161. 9
3	2. 2	2. 0	63	46. 8	42. 2	23	91. 4	82. 3	83	136. 0	122. 5	43	180. 6	162. 6
4	3. 0	2. 7	64	47. 6	42. 8	24	92. 1	83. 0	84	136. 7	123. 1	44	181. 3	163. 3
5	3. 7	3. 3	65	48. 3	43. 5	25	92. 9	83. 6	85	137. 5	123. 8	45	182. 1	163. 9
6	4. 5	4. 0	66	49. 0	44. 2	26	93. 6	84. 3	86	138. 2	124. 5	46	182. 8	164. 6
7	5. 2	4. 7	67	49. 8	44. 8	27	94. 4	85. 0	87	139. 0	125. 1	47	183. 6	165. 3
8	5. 9	5. 4	68	50. 5	45. 5	28	95. 1	85. 6	88	139. 7	125. 8	48	184. 3	165. 9
9	6. 7	6. 0	69	51. 3	46. 2	29	95. 9	86. 3	89	140. 5	126. 5	49	185. 0	166. 6
10	7. 4	6. 7	70	52. 0	46. 8	30	96. 6	87. 0	90	141. 2	127. 1	50	185. 8	167. 3
11	8. 2	7. 4	71	52. 8	47. 5	131	97. 4	87. 7	191	141. 9	127. 8	251	186. 5	168. 0
12	8. 9	8. 0	72	53. 5	48. 2	32	98. 1	88. 3	92	142. 7	128. 5	52	187. 3	168. 6
13	9. 7	8. 7	73	54. 2	48. 8	33	98. 8	89. 0	93	143. 4	129. 1	53	188. 0	169. 3
14	10. 4	9. 4	74	55. 0	49. 5	34	99. 6	89. 7	94	144. 2	129. 8	54	188. 8	170. 0
15	11. 1	10. 0	75	55. 7	50. 2	35	100. 3	90. 3	95	144. 9	130. 5	55	189. 5	170. 6
16	11. 9	10. 7	76	56. 5	50. 9	36	101. 1	91. 0	96	145. 7	131. 1	56	190. 2	171. 3
17	12. 6	11. 4	77	57. 2	51. 5	37	101. 8	91. 7	97	146. 4	131. 8	57	191. 0	172. 0
18	13. 4	12. 0	78	58. 0	52. 2	38	102. 6	92. 3	98	147. 1	132. 5	58	191. 7	172. 6
19	14. 1	12. 7	79	58. 7	52. 9	39	103. 3	93. 0	99	147. 9	133. 2	59	192. 5	173. 3
20	14. 9	13. 4	80	59. 5	53. 5	40	104. 0	93. 7	200	148. 6	133. 8	60	193. 2	174. 0
21	15. 6	14. 1	81	60. 2	54. 2	141	104. 8	94. 3	201	149. 4	134. 5	261	194. 0	174. 6
22	16. 3	14. 7	82	60. 9	54. 9	42	105. 5	95. 0	02	150. 1	135. 2	62	194. 7	175. 3
23	17. 1	15. 4	83	61. 7	55. 5	43	106. 3	95. 7	03	150. 9	135. 8	63	195. 4	176. 0
24	17. 8	16. 1	84	62. 4	56. 2	44	107. 0	96. 4	04	151. 6	136. 5	64	196. 2	176. 7
25	18. 6	16. 7	85	63. 2	56. 9	45	107. 8	97. 0	05	152. 3	137. 2	65	196. 9	177. 3
26	19. 3	17. 4	86	63. 9	57. 5	46	108. 5	97. 7	06	153. 1	137. 8	66	197. 7	178. 0
27	20. 1	18. 1	87	64. 7	58. 2	47	109. 2	98. 4	07	153. 8	138. 5	67	198. 4	178. 7
28	20. 8	18. 7	88	65. 4	58. 9	48	110. 0	99. 0	08	154. 6	139. 2	68	199. 2	179. 3
29	21. 6	19. 4	89	66. 1	59. 6	49	110. 7	99. 7	09	155. 3	139. 8	69	199. 9	180. 0
30	22. 3	20. 1	90	66. 9	60. 2	50	111. 5	100. 4	10	156. 1	140. 5	70	200. 6	180. 7
31	23. 0	20. 7	91	67. 6	60. 9	151	112. 2	101. 0	211	156. 8	141. 2	271	201. 4	181. 3
32	23. 8	21. 4	92	68. 4	61. 6	52	113. 0	101. 7	12	157. 5	141. 9	72	202. 1	182. 0
33	24. 5	22. 1	93	69. 1	62. 2	53	113. 7	102. 4	13	158. 3	142. 5	73	202. 9	182. 7
34	25. 3	22. 8	94	69. 9	62. 9	54	114. 4	103. 0	14	159. 0	143. 2	74	203. 6	183. 3
35	26. 0	23. 4	95	70. 6	63. 6	55	115. 2	103. 7	15	159. 8	143. 9	75	204. 4	184. 0
36	26. 8	24. 1	96	71. 3	64. 2	56	115. 9	104. 4	16	160. 5	144. 5	76	205. 1	184. 7
37	27. 5	24. 8	97	72. 1	64. 9	57	116. 7	105. 1	17	161. 3	145. 2	77	205. 9	185. 3
38	28. 2	25. 4	98	72. 8	65. 6	58	117. 4	105. 7	18	162. 0	145. 9	78	206. 6	186. 0
39	29. 0	26. 1	99	73. 6	66. 2	59	118. 2	106. 4	19	162. 7	146. 5	79	207. 3	186. 7
40	29. 7	26. 8	100	74. 3	66. 9	60	118. 9	107. 1	20	163. 5	147. 2	80	208. 1	187. 4
41	30. 5	27. 4	101	75. 1	67. 6	161	119. 6	107. 7	221	164. 2	147. 9	281	208. 8	188. 0
42	31. 2	28. 1	02	75. 8	68. 3	62	120. 4	108. 4	22	165. 0	148. 5	82	209. 6	188. 7
43	32. 0	28. 8	03	76. 5	68. 9	63	121. 1	109. 1	23	165. 7	149. 2	83	210. 3	189. 4
44	32. 7	29. 4	04	77. 3	69. 6	64	121. 9	109. 7	24	166. 5	149. 9	84	211. 1	190. 0
45	33. 4	30. 1	05	78. 0	70. 3	65	122. 6	110. 4	25	167. 2	150. 6	85	211. 8	190. 7
46	34. 2	30. 8	06	78. 8	70. 9	66	123. 4	111. 1	26	168. 0	151. 2	86	212. 5	191. 4
47	34. 9	31. 4	07	79. 5	71. 6	67	124. 1	111. 7	27	168. 7	151. 9	87	213. 3	192. 0
48	35. 7	32. 1	08	80. 3	72. 3	68	124. 8	112. 4	28	169. 4	152. 6	88	214. 0	192. 7
49	36. 4	32. 8	09	81. 0	72. 9	69	125. 6	113. 1	29	170. 2	153. 2	89	214. 8	193. 4
50	37. 2	33. 5	10	81. 7	73. 6	70	126. 3	113. 8	30	170. 9	153. 9	90	215. 5	194. 0
51	37. 9	34. 1	111	82. 5	74. 3	171	127. 1	114. 4	231	171. 7	154. 6	291	216. 3	194. 7
52	38. 6	34. 8	12	83. 2	74. 9	72	127. 8	115. 1	32	172. 4	155. 2	92	217. 0	195. 4
53	39. 4	35. 5	13	84. 0	75. 6	73	128. 6	115. 8	33	173. 2	155. 9	93	217. 7	196. 1
54	40. 1	36. 1	14	84. 7	76. 3	74	129. 3	116. 4	34	173. 9	156. 6	94	218. 5	196. 7
55	40. 9	36. 8	15	85. 5	77. 0	75	130. 1	117. 1	35	174. 6	157. 2	95	219. 2	197. 4
56	41. 6	37. 5	16	86. 2	77. 6	76	130. 8	117. 8	36	175. 4	157. 9	96	220. 0	198. 1
57	42. 4	38. 1	17	86. 9	78. 3	77	131. 5	118. 4	37	176. 1	158. 6	97	220. 7	198. 7
58	43. 1	38. 8	18	87. 7	79. 0	78	132. 3	119. 1	38	176. 9	159. 3	98	221. 5	199. 4
59	43. 8	39. 5	19	88. 4	79. 6	79	133. 0	119. 8	39	177. 6	159. 9	99	222. 2	200. 1
60	44. 6	40. 1	20	89. 2	80. 3	80	133. 8	120. 4	40	178. 4	160. 6	300	222. 9	200. 7

Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

[For 48 Degrees.

DIFFERENCE OF LATITUDE AND DEPARTURE FOR 43°.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	0.7	0.7	61	44.6	41.6	121	88.5	82.5	181	132.4	123.4	241	176.3	164.4
2	1.5	1.4	62	45.3	42.3	22	89.2	83.2	82	133.1	124.1	42	177.0	165.0
3	2.2	2.0	63	46.1	43.0	23	90.0	83.9	83	133.8	124.8	43	177.7	165.7
4	2.9	2.7	64	46.8	43.6	24	90.7	84.6	84	134.6	125.5	44	178.5	166.4
5	3.7	3.4	65	47.5	44.3	25	91.4	85.2	85	135.3	126.2	45	179.2	167.1
6	4.4	4.1	66	48.3	45.0	26	92.2	85.9	86	136.0	126.9	46	179.9	167.8
7	5.1	4.8	67	49.0	45.7	27	92.9	86.6	87	136.8	127.5	47	180.6	168.5
8	5.9	5.5	68	49.7	46.4	28	93.6	87.3	88	137.5	128.2	48	181.4	169.1
9	6.6	6.1	69	50.5	47.1	29	94.3	88.0	89	138.2	128.9	49	182.1	169.8
10	7.3	6.8	70	51.2	47.7	30	95.1	88.7	90	139.0	129.6	50	182.8	170.5
11	8.0	7.5	71	51.9	48.4	131	95.8	89.3	191	139.7	130.3	251	183.6	171.2
12	8.8	8.2	72	52.7	49.1	32	96.5	90.0	92	140.4	130.9	52	184.3	171.9
13	9.5	8.9	73	53.4	49.8	33	97.3	90.7	93	141.2	131.6	53	185.0	172.5
14	10.2	9.5	74	54.1	50.5	34	98.0	91.4	94	141.9	132.3	54	185.8	173.2
15	11.0	10.2	75	54.9	51.1	35	98.7	92.1	95	142.6	133.0	55	186.5	173.9
16	11.7	10.9	76	55.6	51.8	36	99.5	92.8	96	143.3	133.7	56	187.2	174.6
17	12.4	11.6	77	56.3	52.5	37	100.2	93.4	97	144.1	134.4	57	188.0	175.3
18	13.2	12.3	78	57.0	53.2	38	100.9	94.1	98	144.8	135.0	58	188.7	176.0
19	13.9	13.0	79	57.8	53.9	39	101.7	94.8	99	145.5	135.7	59	189.4	176.6
20	14.6	13.6	80	58.5	54.6	40	102.4	95.5	200	146.3	136.4	60	190.2	177.3
21	15.4	14.3	81	59.2	55.2	141	103.1	96.2	201	147.0	137.1	261	190.9	178.0
22	16.1	15.0	82	60.0	55.9	42	103.9	96.8	02	147.7	137.8	62	191.6	178.7
23	16.8	15.7	83	60.7	56.6	43	104.6	97.5	03	148.5	138.4	63	192.3	179.4
24	17.6	16.4	84	61.4	57.3	44	105.3	98.2	04	149.2	139.1	64	193.1	180.0
25	18.3	17.0	85	62.2	58.0	45	106.0	98.9	05	149.9	139.8	65	193.8	180.7
26	19.0	17.7	86	62.9	58.7	46	106.8	99.6	06	150.7	140.5	66	194.5	181.4
27	19.7	18.4	87	63.6	59.3	47	107.5	100.3	07	151.4	141.2	67	195.3	182.1
28	20.5	19.1	88	64.4	60.0	48	108.2	100.9	08	152.1	141.9	68	196.0	182.8
29	21.2	19.8	89	65.1	60.7	49	109.0	101.6	09	152.9	142.5	69	196.7	183.5
30	21.9	20.5	90	65.8	61.4	50	109.7	102.3	10	153.6	143.2	70	197.5	184.1
31	22.7	21.1	91	66.6	62.1	151	110.4	103.0	211	154.3	143.9	271	198.2	184.8
32	23.4	21.8	92	67.3	62.7	52	111.2	103.7	12	155.0	144.6	72	198.9	185.5
33	24.1	22.5	93	68.0	63.4	53	111.9	104.3	13	155.8	145.3	73	199.7	186.2
34	24.9	23.2	94	68.7	64.1	54	112.6	105.0	14	156.5	145.9	74	200.4	186.9
35	25.6	23.9	95	69.5	64.8	55	113.4	105.7	15	157.2	146.6	75	201.1	187.5
36	26.3	24.6	96	70.2	65.5	56	114.1	106.4	16	158.0	147.3	76	201.9	188.2
37	27.1	25.2	97	70.9	66.2	57	11.8	107.1	17	158.7	148.0	77	202.6	188.9
38	27.8	25.9	98	71.7	66.8	58	115.6	107.8	18	159.4	148.7	78	203.3	189.6
39	28.5	26.6	99	72.4	67.5	59	116.3	108.4	19	160.2	149.4	79	204.0	190.3
40	29.3	27.3	100	73.1	68.2	60	117.0	109.1	20	160.9	150.0	80	204.8	191.0
41	30.0	28.0	101	73.9	68.9	161	117.7	109.8	221	161.6	150.7	281	205.5	191.6
42	30.7	28.6	02	74.6	69.6	62	118.5	110.5	22	162.4	151.4	83	206.2	192.3
43	31.4	29.3	03	75.3	70.2	63	119.2	111.2	23	163.1	152.1	83	207.0	193.0
44	32.2	30.0	04	76.1	70.9	64	119.9	111.8	24	163.8	152.8	84	207.7	193.7
45	32.9	30.7	05	76.8	71.6	65	120.7	112.5	25	164.6	153.4	85	208.4	194.4
46	33.6	31.4	06	77.5	72.3	66	121.4	113.2	26	165.3	154.1	86	209.2	195.1
47	34.4	32.1	07	78.3	73.0	67	122.1	113.9	27	166.0	154.8	87	209.9	195.7
48	35.1	32.7	08	79.0	73.7	68	122.9	114.6	28	166.7	155.5	88	210.6	196.4
49	35.8	33.4	09	79.7	74.3	69	123.6	115.3	29	167.5	156.2	89	211.4	197.1
50	36.6	34.1	10	80.4	75.0	70	124.3	115.9	30	168.2	156.9	90	212.1	197.8
51	37.3	34.8	111	81.2	75.7	171	125.1	116.6	231	168.9	157.5	291	212.8	198.5
52	38.0	35.5	12	81.9	76.4	72	125.8	117.3	32	169.7	158.2	92	213.6	199.1
53	38.8	36.1	13	82.6	77.1	73	126.5	118.0	33	170.4	158.9	93	214.3	199.8
54	39.5	36.8	14	83.4	77.7	74	127.3	118.7	34	171.1	159.6	94	215.0	200.5
55	40.2	37.5	15	84.1	78.4	75	128.0	119.3	35	171.9	160.3	95	215.7	201.2
56	41.0	38.2	16	84.8	79.1	76	128.7	120.0	36	172.6	161.0	96	216.5	201.9
57	41.7	38.9	17	85.6	79.8	77	129.4	120.7	37	173.3	161.6	97	217.2	202.6
58	42.4	39.6	18	86.3	80.5	78	130.2	121.4	38	174.1	162.3	98	217.9	203.2
59	43.1	40.2	19	87.0	81.2	79	130.9	122.1	39	174.8	163.0	99	218.7	203.9
60	43.9	40.9	20	87.8	81.8	80	131.6	122.8	40	175.5	163.7	300	219.4	204.6

Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep	Lat.

[For 47 Degrees.

DIFFERENCE OF LATITUDE AND DEPARTURE FOR 44°.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	0.7	0.7	61	43.9	42.4	121	87.0	84.1	181	130.2	125.7	241	173.4	167.4
2	1.4	1.4	62	44.6	43.1	22	87.8	84.7	82	130.9	126.4	42	174.1	168.1
3	2.2	2.1	63	45.3	43.8	23	88.5	85.4	83	131.6	127.1	43	174.8	168.8
4	2.9	2.8	64	46.0	44.5	24	89.2	86.1	84	132.4	127.8	44	175.5	169.5
5	3.6	3.5	65	46.8	45.2	25	89.9	86.8	85	133.1	128.5	45	176.2	170.2
6	4.3	4.2	66	47.5	45.8	26	90.6	87.5	86	133.8	129.2	46	177.0	170.9
7	5.0	4.9	67	48.2	46.5	27	91.4	88.2	87	134.5	129.9	47	177.7	171.6
8	5.8	5.6	68	48.9	47.2	28	92.1	88.9	88	135.2	130.6	48	178.4	172.3
9	6.5	6.3	69	49.6	47.9	29	92.8	89.6	89	136.0	131.3	49	179.1	173.0
10	7.2	6.9	70	50.4	48.6	30	93.5	90.3	90	136.7	132.0	50	179.8	173.7
11	7.9	7.6	71	51.1	49.3	131	94.2	91.0	191	137.4	132.7	251	180.6	174.4
12	8.6	8.3	72	51.8	50.0	32	95.0	91.7	92	138.1	133.4	52	181.3	175.1
13	9.4	9.0	73	52.5	50.7	33	95.7	92.4	93	138.8	134.1	53	182.0	175.7
14	10.1	9.7	74	53.2	51.4	34	96.4	93.1	94	139.6	134.8	54	182.7	176.4
15	10.8	10.4	75	54.0	52.1	35	97.1	93.8	95	140.3	135.5	55	183.4	177.1
16	11.5	11.1	76	54.7	52.8	36	97.8	94.5	96	141.0	136.2	56	184.2	177.8
17	12.2	11.8	77	55.4	53.5	37	98.5	95.2	97	141.7	136.8	57	184.9	178.5
18	12.9	12.5	78	56.1	54.2	38	99.3	95.9	98	142.4	137.5	58	185.6	179.2
19	13.7	13.2	79	56.8	54.9	39	100.0	96.6	99	143.1	138.2	59	186.3	179.9
20	14.4	13.9	80	57.5	55.6	40	100.7	97.3	200	143.9	138.9	60	187.0	180.6
21	15.1	14.6	81	58.3	56.3	141	101.4	97.9	201	144.6	139.6	261	187.7	181.3
22	15.8	15.3	82	59.0	57.0	42	102.1	98.6	02	145.3	140.3	62	188.5	182.0
23	16.5	16.0	83	59.7	57.7	43	102.9	99.3	03	146.0	141.0	63	189.2	182.7
24	17.3	16.7	84	60.4	58.4	44	103.6	100.0	04	146.7	141.7	64	189.9	183.4
25	18.0	17.4	85	61.1	59.0	45	104.3	100.7	05	147.5	142.4	65	190.6	184.1
26	18.7	18.1	86	61.9	59.7	46	105.0	101.4	06	148.2	143.1	66	191.3	184.8
27	19.4	18.8	87	62.6	60.4	47	105.7	102.1	07	148.9	143.8	67	192.1	185.5
28	20.1	19.5	88	63.3	61.1	48	106.5	102.8	08	149.6	144.5	68	192.8	186.2
29	20.9	20.1	89	64.0	61.8	49	107.2	103.5	09	150.3	145.2	69	193.5	186.9
30	21.6	20.8	90	64.7	62.5	50	107.9	104.2	10	151.1	145.9	70	194.2	187.6
31	22.3	21.5	91	65.5	63.2	151	108.6	104.9	211	151.8	146.6	271	194.9	188.3
32	23.0	22.2	92	66.2	63.9	52	109.3	105.6	12	152.5	147.3	72	195.7	188.9
33	23.7	22.9	93	66.9	64.6	53	110.1	106.3	13	153.2	148.0	73	196.4	189.6
34	24.5	23.6	94	67.6	65.3	54	110.8	107.0	14	153.9	148.7	74	197.1	190.3
35	25.2	24.3	95	68.3	66.0	55	111.5	107.7	15	154.7	149.4	75	197.8	191.0
36	25.9	25.0	96	69.1	66.7	56	112.2	108.4	16	155.4	150.0	76	198.5	191.7
37	26.6	25.7	97	69.8	67.4	57	112.9	109.1	17	156.1	150.7	77	199.3	192.4
38	27.3	26.4	98	70.5	68.1	58	113.7	109.8	18	156.8	151.4	78	200.0	193.1
39	28.1	27.1	99	71.2	68.8	59	114.4	110.5	19	157.5	152.1	79	200.7	193.8
40	28.8	27.8	100	71.9	69.5	60	115.1	111.1	20	158.3	152.8	80	201.4	194.5
41	29.5	28.5	101	72.7	70.2	161	115.8	111.8	221	159.0	153.5	281	202.1	195.2
42	30.2	29.2	02	73.4	70.9	62	116.5	112.5	22	159.7	154.2	82	202.9	195.9
43	30.9	29.9	03	74.1	71.5	63	117.3	113.2	23	160.4	154.9	83	203.6	196.6
44	31.7	30.6	04	74.8	72.2	64	118.0	113.9	24	161.1	155.6	84	204.3	197.3
45	32.4	31.3	05	75.5	72.9	65	118.7	114.6	25	161.9	156.3	85	205.0	198.0
46	33.1	32.0	06	76.3	73.6	66	119.4	115.3	26	162.6	157.0	86	205.7	198.7
47	33.8	32.6	07	77.0	74.3	67	120.1	116.0	27	163.3	157.7	87	206.5	199.4
48	34.5	33.3	08	77.7	75.0	68	120.8	116.7	28	164.0	158.4	88	207.2	200.1
49	35.2	34.0	09	78.4	75.7	69	121.6	117.4	29	164.7	159.1	89	207.9	200.8
50	36.0	34.7	10	79.1	76.4	70	122.3	118.1	30	165.4	159.8	90	208.6	201.5
51	36.7	35.4	111	79.8	77.1	171	123.0	118.8	231	166.2	160.5	291	209.3	202.1
52	37.4	36.1	12	80.6	77.8	72	123.7	119.5	32	166.9	161.2	92	210.0	202.8
53	38.1	36.8	13	81.3	78.5	73	124.4	120.2	33	167.6	161.9	93	210.8	203.5
54	38.8	37.5	14	82.0	79.2	74	125.2	120.9	34	168.3	162.6	94	211.5	204.2
55	39.6	38.2	15	82.7	79.9	75	125.9	121.6	35	169.0	163.2	95	212.2	204.9
56	40.3	38.9	16	83.4	80.6	76	126.6	122.3	36	169.8	163.9	96	212.9	205.6
57	41.0	39.6	17	84.2	81.3	77	127.3	123.0	37	170.5	164.6	97	213.6	206.3
58	41.7	40.3	18	84.9	82.0	78	128.0	123.6	38	171.2	165.3	98	214.4	207.0
59	42.4	41.0	19	85.6	82.7	79	128.8	124.3	39	171.9	166.0	99	215.1	207.7
60	43.2	41.7	20	86.3	83.4	80	129.5	125.0	40	172.6	166.7	300	215.8	208.4

Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

[For 46 Degrees.

DIFFERENCE OF LATITUDE AND DEPARTURE FOR 45°.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	0.7	0.7	61	43.1	43.1	121	85.6	85.6	181	128.0	128.0	241	170.4	170.4
2	1.4	1.4	62	43.8	43.8	22	86.3	86.3	82	128.7	128.7	42	171.1	171.1
3	2.1	2.1	63	44.5	44.5	23	87.0	87.0	83	129.4	129.4	43	171.8	171.8
4	2.8	2.8	64	45.3	45.3	24	87.7	87.7	84	130.1	130.1	44	172.5	172.5
5	3.5	3.5	65	46.0	46.0	25	88.4	88.4	85	130.8	130.8	45	173.2	173.2
6	4.2	4.2	66	46.7	46.7	26	89.1	89.1	86	131.5	131.5	46	173.9	173.9
7	4.9	4.9	67	47.4	47.4	27	89.8	89.8	87	132.2	132.2	47	174.7	174.7
8	5.7	5.7	68	48.1	48.1	28	90.5	90.5	88	132.9	132.9	48	175.4	175.4
9	6.4	6.4	69	48.8	48.8	29	91.2	91.2	89	133.6	133.6	49	176.1	176.1
10	7.1	7.1	70	49.5	49.5	30	91.9	91.9	90	134.4	134.4	50	176.8	176.8
11	7.8	7.8	71	50.2	50.2	131	92.6	92.6	191	135.1	135.1	251	177.5	177.5
12	8.5	8.5	72	50.9	50.9	32	93.3	93.3	92	135.8	135.8	52	178.2	178.2
13	9.2	9.2	73	51.6	51.6	33	94.0	94.0	93	136.5	136.5	53	178.9	178.9
14	9.9	9.9	74	52.3	52.3	34	94.8	94.8	94	137.2	137.2	54	179.6	179.6
15	10.6	10.6	75	53.0	53.0	35	95.5	95.5	95	137.9	137.9	55	180.3	180.3
16	11.3	11.3	76	53.7	53.7	36	96.2	96.2	96	138.6	138.6	56	181.0	181.0
17	12.0	12.0	77	54.4	54.4	37	96.9	96.9	97	139.3	139.3	57	181.7	181.7
18	12.7	12.7	78	55.2	55.2	38	97.6	97.6	98	140.0	140.0	58	182.4	182.4
19	13.4	13.4	79	55.9	55.9	39	98.3	98.3	99	140.7	140.7	59	183.1	183.1
20	14.1	14.1	80	56.6	56.6	40	99.0	99.0	200	141.4	141.4	60	183.8	183.8
21	14.8	14.8	81	57.3	57.3	141	99.7	99.7	201	142.1	142.1	261	184.6	184.6
22	15.6	15.6	82	58.0	58.0	42	100.4	100.4	02	142.8	142.8	62	185.3	185.3
23	16.3	16.3	83	58.7	58.7	43	101.1	101.1	03	143.5	143.5	63	186.0	186.0
24	17.0	17.0	84	59.4	59.4	44	101.8	101.8	04	144.2	144.2	64	186.7	186.7
25	17.7	17.7	85	60.1	60.1	45	102.5	102.5	05	145.0	145.0	65	187.4	187.4
26	18.4	18.4	86	60.8	60.8	46	103.2	103.2	06	145.7	145.7	66	188.1	188.1
27	19.1	19.1	87	61.5	61.5	47	103.9	103.9	07	146.4	146.4	67	188.8	188.8
28	19.8	19.8	88	62.2	62.2	48	104.7	104.7	08	147.1	147.1	68	189.5	189.5
29	20.5	20.5	89	62.9	62.9	49	105.4	105.4	09	147.8	147.8	69	190.2	190.2
30	21.2	21.2	90	63.6	63.6	50	106.1	106.1	10	148.5	148.5	70	190.9	190.9
31	21.9	21.9	91	64.3	64.3	151	106.8	106.8	211	149.2	149.2	271	191.6	191.6
32	22.6	22.6	92	65.1	65.1	52	107.5	107.5	12	149.9	149.9	72	192.3	192.3
33	23.3	23.3	93	65.8	65.8	53	108.2	108.2	13	150.6	150.6	73	193.0	193.0
34	24.0	24.0	94	66.5	66.5	54	108.9	108.9	14	151.3	151.3	74	193.7	193.7
35	24.7	24.7	95	67.2	67.2	55	109.6	109.6	15	152.0	152.0	75	194.5	194.5
36	25.5	25.5	96	67.9	67.9	56	110.3	110.3	16	152.7	152.7	76	195.2	195.2
37	26.2	26.2	97	68.6	68.6	57	111.0	111.0	17	153.4	153.4	77	195.9	195.9
38	26.9	26.9	98	69.3	69.3	58	111.7	111.7	18	154.1	154.1	78	196.6	196.6
39	27.6	27.6	99	70.0	70.0	59	112.4	112.4	19	154.9	154.9	79	197.3	197.3
40	28.3	28.3	100	70.7	70.7	60	113.1	113.1	20	155.6	155.6	80	198.0	198.0
41	29.0	29.0	101	71.4	71.4	101	113.8	113.8	221	156.3	156.3	281	198.7	198.7
42	29.7	29.7	02	72.1	72.1	62	114.6	114.6	22	157.0	157.0	82	199.4	199.4
43	30.4	30.4	03	72.8	72.8	63	115.3	115.3	23	157.7	157.7	83	200.1	200.1
44	31.1	31.1	04	73.5	73.5	64	116.0	116.0	24	158.4	158.4	84	200.8	200.8
45	31.8	31.8	05	74.2	74.2	65	116.7	116.7	25	159.1	159.1	85	201.5	201.5
46	32.5	32.5	06	75.0	75.0	66	117.4	117.4	26	159.8	159.8	86	202.2	202.2
47	33.2	33.2	07	75.7	75.7	67	118.1	118.1	27	160.5	160.5	87	202.9	202.9
48	33.9	33.9	08	76.4	76.4	68	118.8	118.8	28	161.2	161.2	88	203.6	203.6
49	34.6	34.6	09	77.1	77.1	69	119.5	119.5	29	161.9	161.9	89	204.4	204.4
50	35.4	35.4	10	77.8	77.8	70	120.2	120.2	30	162.6	162.6	90	205.1	205.1
51	36.1	36.1	111	78.5	78.5	171	120.9	120.9	231	163.3	163.3	291	205.8	205.8
52	36.8	36.8	12	79.2	79.2	72	121.6	121.6	32	164.0	164.0	92	206.5	206.5
53	37.5	37.5	13	79.9	79.9	73	122.3	122.3	33	164.8	164.8	93	207.2	207.2
54	38.2	38.2	14	80.6	80.6	74	123.0	123.0	34	165.5	165.5	94	207.9	207.9
55	38.9	38.9	15	81.3	81.3	75	123.7	123.7	35	166.2	166.2	95	208.6	208.6
56	39.6	39.6	16	82.0	82.0	76	124.5	124.5	36	166.9	166.9	96	209.3	209.3
57	40.3	40.3	17	82.7	82.7	77	125.2	125.2	37	167.6	167.6	97	210.0	210.0
58	41.0	41.0	18	83.4	83.4	78	125.9	125.9	38	168.3	168.3	98	210.7	210.7
59	41.7	41.7	19	84.1	84.1	79	126.6	126.6	39	169.0	169.0	99	211.4	211.4
60	42.4	42.4	20	84.9	84.9	80	127.3	127.3	40	169.7	169.7	300	212.1	212.1

Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

[For 45 Degrees.

Table II.

REFRACTION, DIP, AND PARALLAX.

Apparent Altitude.		Refraction.		Apparent Altitude.		Refraction.		Apparent Altitude.		Refraction.		Apparent Altitude.		Refraction.		Apparent Altitude.		Refraction.	
°	′	′	″	°	′	′	″	°	′	′	″	°	′	′	″	°	′	′	″
				9	30	5	35	15	0	3	34	25	0	2	4	42	0	1	5
0	0	36	29		35	5	32		10	3	32		10	2	3		20	1	3
1	0	24	53		40	5	29		20	3	29		20	2	2		40	1	3
2	0	18	25		45	5	27		30	3	27		30	2	1	43	0	1	2
3	0	14	25		50	5	24		40	3	25		40	2	1		20	1	2
4	0	11	44		55	5	22		50	3	22		50	2	0		40	1	1
5	0	9	52	10	0	5	19	16	0	3	20	26	0	1	59	44	0	1	0
	5	9	44		5	5	17		10	3	18		10	1	58		20	0	59
	10	9	36		10	5	14		20	3	16		20	1	57		40	0	59
	15	9	28		15	5	12		30	3	14		30	1	56	45	0	0	58
	20	9	21		20	5	9		40	3	12		40	1	55		20	0	57
	25	9	14		25	5	7		50	3	10		50	1	54		40	0	57
5	30	9	7	10	30	5	5	17	0	3	8	27	0	1	54	46	0	0	56
	35	9	0		35	5	2		10	3	6		10	1	53		20	0	55
	40	8	53		40	5	0		20	3	5		20	1	52		40	0	55
	45	8	47		45	4	58		30	3	3		30	1	51	47	0	0	54
	50	8	46		50	4	56		40	3	1		40	1	51		20	0	54
	55	8	34		55	4	53		50	2	59		50	1	50		40	0	53
6	0	8	28	11	0	4	51	18	0	2	57	28	0	1	49	48	0	0	52
	5	8	22		5	4	49		10	2	56		20	1	48	49	0	9	50
	10	8	16		10	4	47		20	2	54		40	1	46	50	0	0	49
	15	8	10		15	4	45		30	2	52	29	0	1	45	51	0	0	47
	20	8	5		20	4	43		40	2	51		20	1	43	52	0	0	45
	25	7	59		25	4	41		50	2	49		40	1	42	53	0	0	44
6	30	7	54	11	30	4	39	19	0	2	48	30	0	1	40	54	0	0	42
	35	7	49		35	4	37		10	2	46		20	1	39	55	0	0	41
	40	7	43		40	4	35		20	2	45		40	1	38	56	0	0	39
	45	7	38		45	4	33		30	2	43	31	0	1	37	57	0	0	37
	50	7	33		50	4	31		40	2	42		20	1	35	58	0	0	36
	55	7	28		55	4	29		50	2	40		40	1	34	59	0	0	35
7	0	7	24	12	0	4	27	20	0	2	39	32	0	1	33	60	0	0	33
	5	7	19		5	4	26		10	2	37		20	1	32	61	0	0	32
	10	7	14		10	4	24		20	2	36		40	1	31	62	0	0	31
	15	7	10		15	4	22		30	2	35	33	0	1	29	63	0	0	30
	20	7	6		20	4	20		40	2	33		20	1	28	64	0	0	28
	25	7	1		25	4	19		50	2	32		40	1	27	65	0	0	27
7	30	6	57	12	30	4	17	21	0	2	31	34	0	1	26	66	0	0	26
	35	6	53		35	4	15		10	2	29		20	1	25	67	0	0	25
	40	6	49		40	4	13		20	2	28		40	1	24	68	0	0	23
	45	6	45		45	4	12		30	2	27	35	0	1	23	69	0	0	22
	50	6	41		50	4	10		40	2	26		20	1	22	70	0	0	21
	55	6	37		55	4	9		50	2	24		40	1	21	71	0	0	20
8	0	6	33	13	0	4	7	22	0	2	23	36	0	1	20	72	0	0	19
	5	6	29		5	4	5		10	2	22		20	1	19	73	0	0	18
	10	6	25		10	4	4		20	2	21		40	1	18	74	0	0	17
	15	6	22		15	4	2		30	2	20	37	0	1	17	75	0	0	15
	20	6	19		20	4	1		40	2	19		20	1	16	76	0	0	14
	25	6	15		25	3	59		50	2	17		40	1	15	77	0	0	13
8	30	6	12	13	30	3	58	23	0	2	16	38	0	1	14	78	0	0	12
	35	6	8		35	3	56		10	2	15		20	1	13	79	0	0	11
	40	6	5		40	3	55		20	2	14		40	1	12	80	0	0	10
	45	6	2		45	3	54		30	2	13	39	0	1	11	81	0	0	9
	50	5	59		50	3	52		40	2	12		20	1	11	82	0	0	8
	55	5	56		55	3	51		50	2	11		40	1	10	83	0	0	8
9	0	5	52	14	0	3	49	24	0	2	10	40	0	1	9	84	0	0	6
	5	5	49		10	3	47		10	2	9		20	1	8	85	0	0	5
	10	5	46		20	3	44		20	2	8		40	1	8	86	0	0	4
	15	5	43		30	3	41		30	2	7	41	0	1	7	87	0	0	3
	20	5	41		40	3	39		40	2	6		20	1	6	88	0	0	2
	25	5	38		50	3	36		50	2	5		40	1	5	89	0	0	1
9	30	5	35	15	0	3	34	25	0	2	4	42	0	1	4	90	0	0	0

Dip of the Sea Horizon.

Height of the Eye.	Dip of the Horizon.
Ft.	′ ″
1	0 59
2	1 23
3	1 42
4	1 58
5	2 11
6	2 24
7	2 36
8	2 46
9	2 56
10	3 06
11	3 15
12	3 24
13	3 32
14	3 40
15	3 48
16	3 55
17	4 02
18	4 09
19	4 16
20	4 23
21	4 29
22	4 36
23	4 42
24	4 48
25	4 54
26	5 00
27	5 06
28	5 11
29	5 17
30	5 22

The Sun's Parallax in Altitude.

Sun's Alt.	Sun's Parallax.
D.	S.
0	9
10	9
20	8
30	8
40	7
50	6
55	5
60	4
65	4
70	3
75	2
80	2
85	1
90	0

Table III.

DECLINATION OF THE SUN,

1886–1901.

DECLINATION OF THE SUN FOR THE YEARS 1886, 1890, 1894, 1898.

Days.	JAN.		FEB.		MAR.		APRIL.		MAY.		JUNE.		Days.
	Dec. South.	Diff. one hour.	Dec. South.	Diff. one hour.	Dec. South / North.	Diff. one hour.	Dec. North.	Diff. one hour.	Dec. North.	Diff. one hour.	Dec. North.	Diff. one hour.	
	° ′	″	° ′	″	° ′	″	° ′	″	° ′	″	° ′	″	
1	22.59	+13	17.02	+43	7.30	+57	4.37	+58	15.08	+45	22.05	+20	1
2	22.54	14	16.44	44	7.07	57	5.00	58	15.26	45	22.13	19	2
3	22.48	15	16.27	44	6.44	57	5.23	57	15.44	44	22.20	18	3
4	22.42	16	16.09	45	6.21	58	5.46	57	16.01	43	22.28	17	4
5	22.35	+17	15 51	+46	5.58	+58	6.09	+57	16.18	+43	22.34	+16	5
6	22.28	18	15.32	46	5.34	58	6.32	57	16.35	42	22.41	15	6
7	22.21	19	15.14	47	5.11	58	6.54	56	16.52	41	22.47	14	7
8	22.13	20	14.55	48	4.48	58	7.17	56	17.08	41	22.52	13	8
9	22.04	22	14.35	48	4.24	59	7.39	56	17.25	40	22.57	12	9
10	21.55	+23	14.16	+49	4.01	+59	8.01	+55	17.40	+39	23.02	+11	10
11	21.46	24	13.56	49	3.37	59	8 23	55	17.56	38	23.06	10	11
12	21.36	25	13.36	50	3.14	59	8.45	55	18.11	38	23.10	9	12
13	21.26	26	13.16	51	2.50	59	9.07	54	18.26	37	23.14	8	13
14	21.16	27	12.55	51	2.26	59	9.29	54	18.40	36	23.17	7	14
15	21.05	+28	12.25	+52	2.03	+59	9.50	+53	18.55	+35	23.20	+6	15
16	20.53	29	12.15	52	1.39	59	10.12	53	19.09	34	23.22	5	16
17	20.42	30	11.54	53	1.15	59	10.32	53	19 22	34	23.24	4	17
18	20.30	31	11.33	53	0.52	59	10.54	52	19.36	33	23.25	3	18
19	20.17	32	11.11	53	0.28	59	11.15	52	19.49	32	23.26	2	19
20	20.04	+33	10.50	+54	**0.04**	+59	11.35	+51	20.01	+31	23.27	+1	20
21	19.51	34	10.28	54	0.19	59	11.56	51	20.13	30	23.27	0	21
22	19.37	35	10.06	55	0.43	59	12.16	50	20.25	29	23.27	−1	22
23	19.23	35	9.44	55	1.07	59	12 36	50	20 37	28	23.26	2	23
24	19.09	36	9.22	55	1.30	59	12.56	49	20.48	28	23.25	3	24
25	18.54	+37	9.00	+56	1.54	+59	13 15	+49	20.59	+27	23.24	−4	25
26	18.39	38	8.38	56	2 17	59	13.35	48	21.10	26	23.22	5	26
27	18.24	39	8.15	56	2.41	59	13.54	48	21.20	25	23.20	6	27
28	18.08	40	7.52	57	3.04	58	14.13	47	21.30	24	23.17	7	28
29	17.52	41	7.30	57	3.28	58	14 31	46	21.39	23	23.14	8	29
30	17.35	+41			3.51	+58	14.50	+46	21.48	+22	23.10	−9	30
31	17.19	42			4.14	58	15.08	45	21.57	21	23.07	10	31
32	17.02	43			4.37	58			22.05	20			32

DECLINATION OF THE SUN FOR THE YEARS 1886, 1890, 1894, 1898.

Days.	JULY.		AUGUST.		SEPT.		OCT.		NOV.		DEC.		Days.
	Dec. North.	Diff. one hour.	Dec. North.	Diff. one hour.	Dec. North / South.	Diff. one hour.	Dec. South.	Diff. one hour.	Dec. South.	Diff. one hour.	Dec. South.	Diff. one hour.	
	° ′	″	° ′	″	° ′	″	° ′	″	° ′	″	° ′	″	
1	23.07	−10	17.59	−38	8.13	−54	3.16	−58	14.30	−48	21.51	−23	1
2	23.02	11	17.44	39	7.52	55	3.39	58	14.49	47	22.00	22	2
3	22.58	12	17.28	39	7.30	55	4.02	58	15.08	47	22.09	21	3
4	22.52	13	17.12	40	7.07	55	4.25	58	15.27	46	22.17	20	4
5	22.47	−14	16.56	−41	6.45	−56	4.48	−58	15.45	−45	22.25	−19	5
6	22.41	15	16.40	41	6.23	56	5.12	58	16.03	45	22.32	18	6
7	22.35	16	16.23	42	6.00	56	5.35	57	16.21	44	22.39	17	7
8	22.28	17	16.06	43	5.38	56	5.57	57	16.39	43	22.45	15	8
9	22.21	18	15.49	43	5.15	57	6.20	57	16.56	43	22.51	14	9
10	22.14	−19	15.32	−44	4.52	57	6.43	−57	17.13	−42	22.57	−13	10
11	22.06	20	15.14	45	4.30	57	7.06	57	17.29	41	23.02	12	11
12	21.58	21	14.56	45	4.07	57	7.28	56	17.46	40	23.06	11	12
13	21.49	22	14.38	46	3.44	57	7.51	56	18.02	40	23.10	10	13
14	21.40	23	14.19	46	3.21	58	8.13	56	18.18	39	23.14	9	14
15	21.31	−24	14.01	−47	2.58	−58	8.36	−55	18.33	−38	23.17	−7	15
16	21.21	25	13.42	47	2.35	58	8.58	55	18.43	37	23.20	6	16
17	21.11	26	13.23	48	2.11	58	9.20	55	19.03	36	23.22	5	17
18	21.01	26	13.03	48	1.48	58	9.42	54	19.17	36	23.24	4	18
19	20.59	27	12.44	49	1.25	58	10.03	54	19.31	35	23.26	3	19
20	20.39	−28	12.24	−50	1.01	−58	10.25	−54	19.45	−34	23.27	−2	20
21	20.27	29	12.04	50	0.30	58	10.46	53	19.58	33	23.27	0	21
22	20.15	30	11.44	50	**0.15**	58	11.08	53	20.11	32	23.27	+1	22
23	20.03	31	11.24	51	0.08	58	11.29	52	20.24	31	23.26	2	23
24	19.51	32	11.03	51	0.32	58	11.50	52	20.36	30	23.25	3	24
25	19.38	−32	10.42	−52	0.55	−58	12.10	−52	20.48	−29	23.24	+4	25
26	19.25	33	10.22	52	1.19	58	12.31	51	21.00	28	23.22	5	26
27	19.11	34	10.01	53	1.42	58	12.51	51	21.11	27	23.20	7	27
28	18.57	35	9.40	53	2.06	58	13.12	50	21.21	26	23.17	8	28
29	18.43	36	9.18	53	2.28	58	13.32	50	21.32	25	23.13	9	29
30	18.29	−36	8.57	−54	2.52	−58	13.51	−49	21.42	−24	23.10	+10	30
31	18.14	37	8.35	54	3.16	58	14.11	49	21.51	23	23.05	11	31
32	17.59	38	8.13	54			14.30	48			23.01	12	32

DECLINATION OF THE SUN FOR THE YEARS 1887, 1891, 1895, 1899.

Days.	JAN.		FEB.		MAR.		APRIL.		MAY.		JUNE.		Days.
	Dec. South.	Diff. one hour.	Dec. South.	Diff. one hour.	Dec. South North.	Diff. one hour.	Dec. North.	Diff. one hour.	Dec. North.	Diff. one hour.	Dec. North.	Diff. one hour.	
	° ′	″	° ′	″	° ′	″	° ′	″	° ′	″	° ′	″	
1	23.01	+12	17.06	+43	7.35	+57	4.32	+58	15.04	+45	22.03	+20	1
2	22.55	13	16.49	43	7.12	57	4.55	58	15.22	45	22.11	19	2
3	22.50	15	16.31	44	6.49	57	5.18	57	15.40	44	22.19	18	3
4	22.44	16	16 13	45	6.26	58	5.40	57	15.57	43	22.26	17	4
5	22.37	+17	15.55	+46	6.03	+58	6.04	+57	16.14	+43	22.33	+17	5
6	22.30	18	15.37	46	5.40	58	6.26	57	16.31	42	22.39	16	6
7	22.23	19	15.18	47	5.17	58	6.49	56	16.48	41	22.45	15	7
8	22.15	20	14.59	47	4.53	58	7.11	56	17.04	41	22.51	14	8
9	22.06	21	14.40	48	4.30	59	7.34	56	17.21	40	22.56	13	9
10	21.58	+22	14.21	+49	4.06	+59	7.56	+55	17.36	+39	23.01	+12	10
11	21.48	23	14.01	49	3.43	59	8.18	55	17.52	39	23.05	10	11
12	21.39	24	13.41	50	3.19	59	8.40	55	18.07	38	23.09	10	12
13	21.29	26	13.21	50	2.56	59	9.02	54	18.22	37	23.13	8	13
14	21.18	27	13.01	51	2.32	59	9.24	54	18.37	36	23.16	7	14
15	21.08	+28	12.40	+51	2.08	+59	9 45	+54	18.51	+35	23.19	+6	15
16	20.56	29	12.20	52	1.45	59	10.06	53	19.05	35	23.21	5	16
17	20.45	30	11.59	52	1.21	59	10.28	53	19.19	34	23.23	4	17
18	20.33	31	11.38	53	0.57	59	10.49	52	19.32	33	23.25	3	18
19	20.20	32	11.16	53	0.34	59	11.09	52	19.45	32	23.26	2	19
20	20.07	+32	10.55	+54	0.10	+59	11.30	+51	19.58	+31	23.27	+1	20
21	19.54	33	10.33	54	0.14	59	11 51	51	20.10	30	23.27	0	21
22	19.41	34	10.12	55	0.37	59	12.11	50	20.23	30	23.27	−1	22
23	19.27	35	9.50	55	1.01	59	12 31	50	20.34	29	23.26	2	23
24	19.12	36	9.28	55	1.24	59	12.51	49	20.46	28	23.25	3	24
25	18.58	+37	9.05	+56	1.48	+59	13.10	+49	20.57	+27	23.24	−4	25
26	18.43	38	8.43	56	2.12	59	13.30	48	21.07	26	23.22	5	26
27	18.27	39	8.20	56	2.35	59	13.49	48	21.17	25	23.20	6	27
28	18.12	39	7.58	57	2.59	59	14.08	47	21.27	24	23.18	7	28
29	17.56	40	7.35	57	3.22	59	14 27	47	21.37	23	23.15	8	29
30	17.39	+41			3.45	+58	14.45	+46	21.46	22	23.11	−9	30
31	17.23	42			4.09	58	15.04	45	21.55	21	23.08	10	31
32	17.06	43			4.32	58			22.03	20			32

DECLINATION OF THE SUN FOR THE YEARS 1887, 1891, 1895, 1899.

Days.	JULY.		AUG.		SEPT.		OCT.		NOV.		DEC.		Days.
	Dec. North.	Diff. one hour.	Dec. North.	Diff. one hour.	Dec. North South.	Diff. one hour.	Dec. South.	Diff. one hour.	Dec. South.	Diff. one hour.	Dec. South.	Diff. one hour.	
	° ′	″	° ′	″	° ′	″	° ′	″	° ′	″	° ′	″	
1	23.08	−10	18.03	−38	8.19	−54	3.10	−58	14.26	−48	21.49	−23	1
2	23.08	11	17.48	38	7.57	55	3.33	58	14.45	47	21.58	22	2
3	22.59	12	17.32	39	7.35	55	3.56	58	15.04	47	22.07	21	3
4	22.54	13	17.16	40	7.13	55	4.20	58	15.22	46	22.15	20	4
5	22.48	−14	17.00	−41	6.51	−56	4.43	−58	15.41	−46	22.23	−19	5
6	22.43	15	16.44	41	6.28	56	5.06	58	15.59	45	22.30	18	6
7	22.36	16	16.27	42	6.06	56	5.29	57	16.17	44	22.37	17	7
8	22.30	17	16.10	42	5.43	56	5.52	57	16.34	44	22.44	16	8
9	22.23	18	15.53	43	5.21	57	6.15	57	16.52	43	22.50	15	9
10	22.15	−19	15.36	−44	4.58	−57	6.37	−57	17.09	−42	22.55	−13	10
11	22.08	20	15.18	44	4.35	57	7.00	57	17.25	41	23.01	12	11
12	22.00	21	15.00	45	4.12	57	7.23	56	17.42	41	23.05	11	12
13	21.51	22	14.42	46	3.49	57	7.45	56	17.58	40	23.10	10	13
14	21.42	23	14.24	46	3.26	58	8.08	56	18.14	39	23.13	9	14
15	21.33	−23	14.05	−47	3.03	−58	8.30	−55	18.29	−38	23.17	−8	15
16	21.23	24	13.46	47	2.40	58	8.52	55	18.44	37	23.20	7	16
17	21.13	25	13.27	48	2.17	58	9.14	55	18.59	37	23.22	5	17
18	21.03	26	13 08	48	1.54	58	9.36	55	19.14	36	23 24	4	18
19	20.52	27	12.48	49	1.30	58	9.58	54	19.28	35	23.25	3	19
20	20.41	−28	12.29	−49	1.07	−58	10.20	−54	19.42	−34	23.26	−2	20
21	20.30	29	12.09	50	0.44	58	10.41	53	19 55	33	23.27	1	21
22	20.18	30	11.49	50	0.20	58	11.02	53	20.08	32	23.27	+0	22
23	20.06	31	11.28	51	0.03	58	11.24	52	20.21	31	23.27	2	23
24	19.54	31	11.08	51	0.26	58	11.45	52	20.33	30	23.26	3	24
25	19.41	−32	10.48	−52	0.50	−58	12.05	−52	20.45	−29	23 24	+4	25
26	19.28	33	10.27	52	1.13	58	12.26	52	20.57	28	23.23	5	26
27	19.14	34	10.06	53	1.35	58	12.46	51	21.08	27	23.20	6	27
28	19.01	35	9.45	53	2.00	58	13.07	50	21.19	26	23.18	7	28
29	18.47	35	9.23	53	2.23	58	13.27	50	21.29	25	23.14	9	29
30	18.33	−36	9.02	−54	2.47	−58	13.47	−49	21.39	−24	23.10	+10	30
31	18.18	37	8.40	54	3.10	58	14.06	49	21.49	23	23.06	11	31
32	18.03	38	8.19	54			14.25	48			23.02	12	32

DECLINATION OF THE SUN FOR THE YEARS 1888, 1892, 1896, 1900.

Days.	JAN.		FEB.		MARCH.		APRIL.		MAY.		JUNE.		Days.
	Dec. South.	Diff. one hour.	Dec. South.	Diff. one hour.	Dec. South. North	Diff. one hour.	Dec. North.	Diff. one hour.	Dec. North.	Diff. one hour.	Dec. North.	Diff. one hour.	
	° ′	″	° ′	″	° ′	″	° ′	″	° ′	″	° ′	″	
1	23.02	+12	17.10	+42	7.17	+57	4.49	+58	15.17	+45	22.09	+20	1
2	22.57	13	16.53	43	6.55	57	5.12	57	15.35	44	22.17	19	2
3	22.51	14	16.35	44	6.32	58	5.35	57	15.53	44	22.24	18	3
4	22.45	15	16.18	45	6.09	58	5.58	57	16.10	43	22.31	17	4
5	22.39	+17	16.00	+45	5.46	+58	6.21	+57	16.27	+42	22.38	+16	5
6	22.32	18	15.41	46	5.22	58	6.44	56	16.44	42	22.44	15	6
7	22.24	19	15.23	47	4.59	58	7.06	56	17.01	41	22.49	14	7
8	22.17	20	15.04	47	4.35	59	7.28	56	17.17	40	22.55	13	8
9	22.08	21	14.45	48	4.12	59	7.51	55	17.33	39	23.00	12	9
10	22.00	+22	14.25	+49	3.49	+59	8.13	+55	17.48	+39	23.04	+11	10
11	21.51	23	14.06	49	3.25	59	8.35	55	18.04	38	23.08	10	11
12	21.41	24	13.46	50	3.01	59	8.57	54	18.19	37	23.12	9	12
13	21.31	25	13.26	50	2.38	59	9.18	54	18.33	36	23.15	8	13
14	21 21	26	13.06	51	2.14	59	9.40	54	18.48	36	23.18	7	14
15	21.10	+27	12.45	+51	1.50	+59	10.01	+53	19.02	+35	23.21	+6	15
16	20.59	28	12.25	52	1.27	59	10.23	53	19.16	34	23.23	5	16
17	20.47	29	12.04	52	1.03	59	10.44	52	19.29	33	23.25	4	17
18	20.35	30	11.43	53	0.39	59	11.05	52	19.42	32	23.25	3	18
19	20.23	31	11.21	53	**0.16**	59	11.25	51	19.55	31	23.27	2	19
20	20.10	+32	11.00	+54	0.08	+59	11.46	+51	20.08	+31	23.27	+0	20
21	19.57	33	10.38	54	0.32	59	12.06	50	20.20	30	23.27	−0	21
22	19.44	34	10.17	54	0.55	59	12.26	50	20.32	29	23.27	1	22
23	19.30	35	9.55	54	1.19	59	12.46	49	20.43	28	23.26	2	23
24	19.16	35	9.33	55	1.43	59	13.06	49	20.54	27	23.25	4	24
25	19.01	+37	9.11	+56	2.06	+59	13.25	+48	21.05	+26	23.23	−5	25
26	18.46	38	8.48	57	2.30	59	13.45	48	21.15	25	23.21	6	26
27	18.31	38	8.26	57	2.53	59	14.04	47	21.25	24	23.18	7	27
28	18.15	39	8.03	57	3.16	58	14.22	47	21.35	23	23.15	8	28
29	18.00	40	7.41	57	3.40	58	14.41	46	21.44	23	23.12	9	29
30	17.43	+41	7.18	+57	4.03	+58	14.59	+45	21.53	+22	23.09	−10	30
31	17.27	41			4.26	57	15.17	45	22.01	21	23.04	11	31
32	17.10	42			4.49	57			22.09	20			32

DECLINATION OF THE SUN FOR THE YEARS 1888, 1892, 1896, 1900.

Days.	July.		Aug.		Sept.		Oct.		Nov.		Dec.		Days.
	Dec. North.	Diff. one hour.	Dec. North.	Diff. one hour.	Dec. North / South.	Diff. one hour.	Dec. South.	Diff. one hour.	Dec. South.	Diff. one hour.	Dec. South.	Diff. one hour.	
	° ′	″	° ′	″	° ′	″	° ′	″	° ′	″	° ′	″	
1	23.04	−11	17.51	−38	8.02	−55	3.27	−58	14.40	−48	21.56	−22	1
2	23.00	12	17.36	39	7.40	55	3.51	58	14.59	47	22.04	21	2
3	22.55	13	17.20	40	7.18	55	4.14	58	15.18	46	22.13	20	3
4	22.50	14	17.04	40	6.56	56	4.37	58	15.36	46	22.21	19	4
5	22.44	−15	16.48	−41	6.34	−56	5.00	−58	15.54	−45	22.28	−18	5
6	22.38	16	16.31	42	6.11	56	5.23	58	16.12	44	22.35	17	6
7	22.31	17	16 15	42	5.49	56	5.46	57	16 30	44	22.42	16	7
8	22.25	18	15.57	43	5.26	57	6.09	57	16.47	43	22.48	15	8
9	22.17	19	15.40	44	5.04	57	6.32	57	17.04	42	22.54	14	9
10	22.10	−20	15.23	−44	4.41	−57	6.55	−57	17.21	−42	22.59	−13	10
11	22.02	20	15.05	45	4.18	57	7.17	56	17.38	41	23.04	11	11
12	21.53	21	14.47	45	3.55	57	7.40	56	17.54	40	23.09	10	12
13	21.44	22	14.28	46	3.32	58	8.02	56	18.10	39	23.12	9	13
14	21.35	23	14.10	47	3.09	58	8.25	56	18.25	38	23.16	8	14
15	21.26	−24	13.51	−47	2.46	−58	8.47	−55	18.41	−38	23.19	−7	15
16	21.16	25	13.32	48	2.23	58	9.09	55	18.56	37	23.21	6	16
17	21.06	26	13.13	48	1.59	58	9.10	55	19.10	36	23.24	5	17
18	20.55	27	12.53	49	1.36	58	9.53	54	19.24	35	23.25	3	18
19	20.44	28	12.34	49	1.13	58	10.14	54	19.38	34	23.26	2	19
20	20.33	−29	12.14	−50	0.50	−58	10.36	−54	19.52	−33	23.27	−1	20
21	20.21	29	11.54	50	0.26	58	10.57	53	20.05	32	23.27	+0	21
22	20.09	30	11.34	51	**0.03**	58	11.18	53	20.18	31	23.27	1	22
23	19.57	31	11.13	51	0.20	58	11.39	52	20.30	31	23.26	2	23
24	19.44	32	10.53	52	0.44	58	12.00	52	20.42	30	23.25	4	24
25	19.31	−33	10.32	−52	1.07	−58	12.21	−51	20.64	−29	23.23	+5	25
26	19.18	34	10.11	52	1.31	58	12.41	51	21.05	28	23.21	6	26
27	19.04	34	9.50	53	1.54	58	13.02	50	21.16	27	23.18	7	27
28	18.50	35	9.29	53	2.17	58	13.22	50	21.27	26	23.15	8	28
29	18.36	36	9.07	54	2.41	58	13.42	49	21.37	25	23.12	9	29
30	18.21	−37	8.46	−54	3.04	−58	14.01	−49	21.46	−24	23.07	+11	30
31	18.07	37	8.24	54	3.27	58	14.21	48	21.56	23	23.03	11	31
32	17.51	38	8.02	55			14.40	48			22.58	13	32

DECLINATION OF THE SUN FOR THE YEARS 1889, 1893, 1897, 1901.

Days.	Jan.		Feb.		March.		April.		May.		June.		Days.
	Dec. South.	Diff. one hour.	Dec. South.	Diff. one hour.	Dec. South. North	Diff. one hour.	Dec. North.	Diff. one hour.	Dec. North.	Diff. one hour.	Dec. North.	Diff. one hour.	
	° ′	″	° ′	″	° ′	″	° ′	″	° ′	″	° ′	″	
1	22.58	+13	16.57	+43	7.23	+57	4.44	+58	15.13	+45	22.07	+20	1
2	22.53	14	16.40	44	7.00	57	5.07	57	15.31	44	22.15	19	2
3	22.47	15	16.22	44	6.37	58	5.30	57	15.49	44	22.22	18	3
4	22.40	16	16.04	45	6.14	58	5.53	57	16.06	43	22.30	17	4
5	22.34	+17	15.46	+46	5.51	+58	6.15	+57	16.23	+42	22.36	+16	5
6	22.26	19	15.27	47	5.28	58	6.38	56	16.40	42	22.42	15	6
7	22.19	20	15.08	47	5.05	58	7.01	56	16.57	41	22.48	14	7
8	22.11	21	14.49	48	4.41	58	7.23	56	17.13	40	22.54	13	8
9	22.02	22	14.30	48	4.18	59	7.45	56	17.29	40	22.59	12	9
10	21.53	+23	14.11	+49	3.54	+59	8.08	+55	17.45	+39	23.03	+11	10
11	21.44	24	13.51	50	3.31	59	8.30	55	18.00	38	23.07	10	11
12	21.34	25	13.31	50	3.07	59	8.51	54	18.15	37	23.11	9	12
13	21.24	26	13.11	51	2.43	59	9.13	54	18.30	37	23.15	8	13
14	21.13	27	12.50	51	2.20	59	9.35	54	18.44	36	23.18	7	14
15	21.02	+28	12.30	+52	1.56	+59	9.56	+53	18.59	+35	23.20	+6	15
16	20.50	29	12.09	52	1.32	59	10.17	53	19.12	34	23.22	5	16
17	20.38	30	11.48	53	1.09	59	10.39	52	19.26	33	23.24	4	17
18	20.26	31	11.27	53	0.45	59	10.59	52	19.39	33	23.26	3	18
19	20.14	32	11.05	54	0.21	59	11.20	52	19.52	32	23.26	2	19
20	20.01	+33	10.44	+54	0.02	+59	11.41	+51	20.05	+31	23.27	+1	20
21	19.47	34	10.22	54	0.26	59	12.01	51	20.17	30	23.27	−0	21
22	19.33	35	10.00	55	0.49	59	12.21	50	20.29	29	23.27	1	22
23	19.19	36	9.38	55	1.13	59	12.41	50	20.40	28	23.26	2	23
24	19.05	37	9.16	56	1.37	59	13.01	49	20.51	27	23.25	3	24
25	18.50	+37	8.54	+56	2.00	+59	13.21	+49	21.02	+26	23.23	−4	25
26	18.35	38	8.31	56	2.24	59	13.40	48	21.12	26	23.21	5	26
27	18.19	39	8.09	57	2.47	59	13.59	47	21.23	25	23.19	6	27
28	18.03	40	7.46	57	3.11	58	14.18	47	21.32	24	23.16	7	28
29	17.47	41	7.23	57	3.34	58	14.36	46	21.42	23	23.13	8	29
30	17.31	+42			3.57	+58	14.55	+46	21.51	+22	23.09	−9	30
31	17.14	42			4.21	58	15.13	45	21.59	21	23.05	10	31
32	16.57	43			4.44	58			22.07	20			32

DECLINATION OF THE SUN FOR THE YEARS 1889, 1893, 1897, 1901.

Days.	July.		Aug.		Sept.		Oct.		Nov.		Dec.		Days.
	Dec. North.	Diff. one hour.	Dec. North.	Diff. one hour.	Dec. North. South.	Diff. one hour.	Dec. South.	Diff. one hour.	Dec. South.	Diff. one hour.	Dec. South.	Diff. one hour.	
	° ′	″	° ′	″	° ′	″	° ′	″	° ′	″	° ′	″	
1	23.06	−11	17.55	−38	8.07	−55	3.22	−58	14.35	−48	21.54	−23	1
2	23.01	12	17.40	39	7.46	55	3.45	58	14.54	47	22.02	22	2
3	22.56	13	17.24	39	7.24	55	4.08	58	15.13	47	22.11	21	3
4	22.51	16	17.08	40	7.01	55	4.31	58	15.32	46	22.19	20	4
5	22.45	−15	16.52	−41	6.39	−56	4.55	−58	15.50	−45	22.27	−18	5
6	22.39	16	16.35	41	6.17	56	5.18	57	16.08	45	22.34	17	6
7	22.33	17	16.19	42	5.54	56	5.41	57	16.26	44	22.41	16	7
8	22.26	18	16.01	43	5.32	56	6.04	57	16.43	43	22.47	15	8
9	22.19	19	15.44	43	5.09	57	6.26	57	17.00	43	22.53	14	9
10	22.12	−20	15.27	−44	4.46	−57	6.49	−57	17.17	−42	22.58	−13	10
11	22.04	20	15.09	45	4.23	57	7.12	56	17.34	41	23.03	12	11
12	21.55	21	14.51	45	4.01	57	7.34	56	17.50	40	23.07	11	12
13	21.47	22	14.33	46	3.38	57	7.57	56	18.06	39	23.12	10	13
14	21.38	23	14.14	46	3.15	58	8.19	56	18.22	39	23.15	8	14
15	21.28	−24	13.54	−47	2.51	−58	8.41	−55	18.37	−38	23.18	−7	15
16	21.18	25	13.37	48	2.28	58	9.04	55	18.52	37	23.21	6	16
17	21.08	26	13.17	48	2.05	58	9.26	55	19.07	36	23.23	5	17
18	20.58	27	12.58	49	1.42	58	9.47	54	19.21	35	23.25	4	18
19	20.47	28	12 38	49	1.19	58	10.09	54	19.35	34	23.26	2	19
20	20.36	−28	12.19	−50	0.55	−58	10.31	−54	19.49	−34	23.27	−1	20
21	20.24	29	11.59	50	0.32	58	10.52	53	20.02	33	23.27	0	21
22	20.12	30	11.39	51	**0.08**	58	11.13	53	20.15	32	23.27	+1	22
23	20.00	31	11.18	51	0.15	58	11.34	52	20.27	31	23.26	2	23
24	19.47	31	10.58	51	0.38	58	11.55	52	20.40	30	23.25	3	24
25	19.34	−33	10.37	−52	1.02	−58	12.16	−51	20.51	−29	23 24	+5	25
26	19.21	33	10.16	52	1.25	58	12.37	51	21.03	28	23.22	6	26
27	19.08	34	9.55	53	1.48	58	12.57	51	21.14	27	23.19	7	27
28	18.54	35	9.34	53	2.12	58	13.17	50	21.24	26	23.16	8	28
29	18.39	36	9.12	53	2.35	58	13.37	49	21.34	25	23.12	9	29
30	18.25	−37	8.51	−54	2.58	−58	13.57	−49	21.44	−24	23.09	+10	30
31	18.10	37	8.29	54	3.27	58	14.16	48	21.53	23	23.04	12	31
32	17.55	38	8.08	55			14.35	48			22.59	13	32

Table IV.

EQUATION OF TIME,

1886–1901.

EQUATION OF TIME FOR THE YEARS 1886, 1890, 1894, 1898.

Days.	JAN.	FEB.	MAR.	APR.	MAY.	JUNE.	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
	Add to app. time.	Add to app. time.	Add to app. time.	Add to / Sub. from app. time.	Sub. from app. time.	Sub. from / Add to app. time.	Add to app. time.	Add to app. time.	Sub. from app. time.	Sub. from app. time.	Sub. from app. time.	Sub. from / Add to app. time.
	M. S.	M. S.	M. S.	M. S.	M. S.	M. S.	M. S.	M. S.	M. S.	M. S.	M. S.	M. S.
1	3 53	13 51	12 30	3 54	3 02	2 27	3 33	6 05	0 08	10 21	16 18	10 44
2	4 21	13 58	12 18	3 36	3 10	2 18	3 44	6 01	0 27	10 40	16 18	10 21
3	4 49	14 05	12 05	3 18	3 16	2 08	3 55	5 57	0 46	10 58	16 18	9 58
4	5 16	14 10	11 52	3 00	3 22	1 58	4 06	5 52	1 05	11 17	16 18	9 33
5	5 43	14 15	11 38	2 43	3 27	1 47	4 17	5 46	1 25	11 35	16 16	9 09
6	6 10	14 20	11 24	2 25	3 32	1 37	4 27	5 40	1 45	11 52	16 14	8 43
7	6 36	14 23	11 10	2 08	3 37	1 26	4 37	5 33	2 05	12 09	16 10	8 18
8	7 02	14 25	10 55	1 51	3 41	1 14	4 47	5 25	2 26	12 26	16 06	7 51
9	7 27	14 27	10 40	1 34	3 44	1 03	4 56	5 17	2 46	12 42	16 02	7 25
10	7 51	14 28	10 25	1 18	3 46	0 51	5 04	5 09	3 07	12 58	15 56	6 57
11	8 15	14 28	10 09	1 02	3 49	0 39	5 13	4 59	2 28	13 14	15 49	6 30
12	8 38	14 27	9 53	0 46	3 50	0 27	5 20	4 49	3 46	13 29	15 42	6 02
13	9 01	14 26	9 36	0 30	3 51	0 15	5 28	4 39	4 10	13 43	15 34	5 34
14	9 23	14 24	9 19	**0 15**	3 51	**0 02**	5 34	4 28	4 31	13 57	15 25	5 05
15	9 44	14 21	9 02	0 00	3 51	0 10	5 41	4 17	4 52	14 11	15 15	4 36
16	10 05	14 17	8 45	0 15	3 51	0 23	5 46	4 05	3 14	14 24	15 04	4 07
17	10 24	14 13	8 27	0 29	3 49	0 36	5 52	3 52	5 35	14 36	14 52	3 38
18	10 44	14 07	8 10	0 43	3 48	0 49	5 57	3 39	5 56	14 47	14 40	3 08
19	11 02	14 02	7 52	0 57	3 45	1 02	6 01	3 26	6 17	14 58	14 26	2 38
20	11 20	13 55	7 34	1 10	3 42	1 14	6 04	3 12	6 38	15 09	14 12	2 09
21	11 37	13 48	7 15	1 22	3 39	1 27	6 08	2 57	6 59	15 18	13 57	1 39
22	11 53	13 40	6 57	1 35	3 35	1 40	6 10	2 42	7 20	15 27	13 41	1 09
23	12 08	13 32	6 39	1 47	3 30	1 53	6 12	2 27	7 41	15 36	13 24	0 38
24	12 23	13 23	6 20	1 58	3 25	2 06	6 14	2 11	8 02	15 43	13 07	**0 08**
25	12 36	13 13	6 02	2 09	3 20	2 19	6 15	1 55	8 22	15 50	12 49	0 22
26	12 49	13 03	5 43	2 19	3 14	2 32	6 15	1 39	8 43	15 56	12 30	0 51
27	13 02	12 53	5 25	2 29	3 07	2 44	6 15	1 22	9 03	16 02	12 10	1 21
28	13 13	12 42	5 07	2 38	3 00	2 57	6 14	1 04	9 23	16 07	11 50	1 51
29	13 24	12 30	4 48	2 47	2 52	3 09	6 13	0 47	9 42	16 10	11 29	2 20
30	13 33		4 30	2 55	2 44	3 21	6 11	0 29	10 02	16 14	11 07	2 49
31	13 42		4 12	3 02	2 36	3 33	6 08	0 11	10 21	16 16	10 44	3 18

EQUATION OF TIME FOR THE YEARS 1887, 1891, 1895, 1899.

Days.	JAN.	FEB.	MAR.	APR.	MAY.	JUNE.	JULY.	AUG.	SEPT.	OCT.	NOV.	DEC.
	Add to app. time.	Add to app. time.	Add to app. time.	Add to / Sub. from app. time.	Sub. from app. time.	Sub. from / Add to app. time.	Add to app. time.	Add to app. time.	Sub. from app. time.	Sub. from app. time.	Sub. from app. time.	Sub. from / Add to app. time.
	M. S.	M. S.	M. S.	M. S.	M. S.	M. S.	M. S.	M. S.	M. S.	M. S.	M. S.	M. S.
1	3 47	13 49	12 33	3 59	3 00	2 28	3 30	6 06	0 04	10 17	16 18	10 51
2	4 15	13 57	12 21	3 41	3 07	2 19	3 42	6 02	0 23	10 36	16 20	10 28
3	4 43	14 04	12 09	3 23	3 14	2 10	3 53	5 58	0 42	10 55	16 20	10 04
4	5 10	14 09	11 56	3 05	3 20	2 00	4 04	5 52	1 02	11 13	16 19	9 40
5	5 37	14 14	11 42	2 47	3 26	1 50	4 14	5 47	1 21	11 32	16 18	9 16
6	6 04	14 18	11 28	2 29	3 31	1 39	4 25	5 41	1 41	11 49	16 16	8 51
7	6 30	14 22	11 14	2 12	3 36	1 29	4 34	5 34	2 02	12 07	16 13	8 25
8	6 55	14 24	10 59	1 55	3 40	1 17	4 44	5 26	2 22	12 23	16 09	7 59
9	7 20	14 26	10 44	1 38	3 43	1 06	4 53	5 18	2 42	12 40	16 04	7 32
10	7 45	14 27	10 28	1 21	3 46	0 54	5 02	5 10	3 03	12 56	15 58	7 05
11	8 09	14 27	10 12	1 05	3 48	0 43	5 10	5 01	3 24	13 11	15 52	6 37
12	8 32	14 27	9 56	0 49	3 50	0 30	5 18	4 51	3 45	13 26	15 45	6 09
13	8 55	14 25	9 39	0 33	3 51	0 18	5 25	4 41	4 06	13 41	15 36	5 41
14	9 17	14 23	9 23	0 18	3 52	**0 06**	5 32	4 30	4 27	13 55	15 27	5 12
15	9 38	14 21	9 06	**0 03**	3 52	0 07	5 39	4 19	4 48	14 08	15 17	4 43
16	9 59	14 17	8 48	0 12	3 51	0 20	5 45	4 07	5 09	14 22	15 07	4 14
17	10 19	14 13	8 31	0 26	3 50	0 33	5 50	3 55	5 30	14 33	14 55	3 44
18	10 38	14 08	8 13	0 40	3 48	0 46	5 56	3 42	5 51	14 45	14 43	3 14
19	10 57	14 03	7 56	0 53	3 46	0 59	6 00	3 29	6 12	14 56	14 29	2 45
20	11 15	13 57	7 38	1 07	3 43	1 12	6 04	3 15	6 33	15 06	14 15	2 15
21	11 32	13 50	7 20	1 19	3 39	1 25	6 07	3 01	6 54	15 16	14 00	1 45
22	11 49	13 42	7 02	1 31	3 35	1 38	6 10	2 46	7 15	15 25	13 45	1 15
23	12 04	13 34	6 43	1 43	3 31	1 51	6 13	2 31	7 36	15 34	13 28	0 45
24	12 19	13 26	6 25	1 54	3 26	2 04	6 14	2 15	7 57	15 42	13 11	**0 15**
25	12 33	13 16	6 07	2 05	3 20	2 17	6 15	2 00	8 17	15 49	12 53	0 15
26	12 47	13 06	5 49	2 16	3 14	2 30	6 16	1 43	8 38	15 55	12 34	0 45
27	12 59	12 56	5 30	2 25	3 08	2 42	6 16	1 26	8 58	16 01	12 15	1 14
28	13 11	12 45	5 12	2 35	3 01	2 55	6 15	1 09	9 18	16 06	11 55	1 44
29	13 22	12 33	4 53	2 44	2 53	3 07	6 14	0 51	9 38	16 10	11 34	2 13
30	13 32		4 35	2 52	2 45	3 19	6 12	0 33	9 58	16 14	11 13	2 42
31	13 41		4 17	2 60	2 37	3 30	6 09	0 15	10 17	16 16	10 51	3 11

EQUATION OF TIME FOR THE YEARS 1888, 1892, 1896, 1900.

Days.	JAN.	FEB.	MAR.	APR.	MAY.	JUNE.	JULY.	AUG.	SEPT.	OCT.	NOV.	DEC.
	Add to app. time.	Add to app. time.	Add to app. time.	Add to / Sub. from app. time.	Sub. from app. time.	Sub. from / Add to app. time.	Add to app. time.	Add to / Sub. from app. time.	Sub. from app. time.	Sub. from app. time.	Sub. from app. time.	Sub. from / Add to app. time.
	M. S.	M. S.	M. S.	M. S.	M. S.	M. S.	M. S.	M. S.	M. S.	M. S.	M. S.	M. S.
1	3 40	13 48	12 25	3 45	3 05	2 22	3 38	6 02	0 19	10 33	16 20	10 34
2	4 08	13 55	12 12	3 27	3 12	2 12	3 50	5 58	0 38	10 52	16 21	10 11
3	4 36	14 02	11 59	3 10	3 18	2 02	4 01	5 53	0 58	11 10	16 20	9 47
4	5 03	14 08	11 46	2 52	3 24	1 52	4 12	5 48	1 17	11 28	16 19	9 22
5	5 30	14 14	11 32	2 34	3 29	1 42	4 22	5 42	1 37	11 46	16 17	8 57
6	5 57	14 18	11 18	2 17	3 34	1 31	4 32	5 35	1 57	12 03	16 14	8 31
7	6 23	14 22	11 03	2 00	3 38	1 20	4 42	5 28	2 17	12 20	16 10	8 05
8	6 49	14 25	10 48	1 43	3 42	1 08	4 51	5 20	2 37	12 36	16 06	7 38
9	7 14	14 27	10 33	1 27	3 45	0 56	5 00	5 12	2 58	12 52	16 00	7 11
10	7 39	14 28	10 17	1 10	3 47	0 45	5 09	5 03	3 19	13 08	15 54	6 44
11	8 03	14 29	10 01	0 54	3 49	0 32	5 17	4 54	3 40	13 23	15 47	6 16
12	8 27	14 29	9 45	0 39	3 50	0 20	5 24	4 44	4 01	13 38	15 39	5 48
13	8 50	14 28	9 28	0 23	3 50	**0 07**	5 31	4 33	4 22	13 52	15 30	5 19
14	9 13	14 26	9 12	**0 08**	3 50	0 05	5 38	4 22	4 23	14 05	15 21	4 50
15	9 34	14 23	8 55	0 06	3 50	0 18	5 44	4 10	5 04	14 19	15 10	4 21
16	9 55	14 20	8 37	0 21	3 49	0 31	5 50	3 58	5 25	14 31	14 59	3 52
17	10 16	14 16	8 20	0 35	3 47	0 44	5 55	3 45	5 47	14 43	14 47	3 23
18	10 35	14 12	8 02	0 48	3 45	0 57	5 59	3 32	6 08	14 54	14 34	2 53
19	10 54	14 06	7 44	1 02	3 42	1 10	6 03	3 18	6 29	15 05	14 20	2 23
20	11 12	14 00	7 26	1 15	3 39	1 22	6 07	3 04	6 50	15 15	14 06	1 54
21	11 30	13 53	7 08	1 27	3 35	1 35	6 10	2 49	7 11	15 25	13 50	1 24
22	11 46	13 46	6 50	1 39	3 31	1 48	6 12	2 34	7 32	15 33	13 34	0 54
23	12 02	13 38	6 31	1 50	3 26	2 01	6 13	2 18	7 53	15 42	13 17	**0 24**
24	12 17	13 29	6 13	2 02	3 21	2 14	6 14	2 02	8 14	15 49	12 59	0 06
25	12 31	13 20	5 54	2 12	3 15	2 26	6 15	1 46	8 34	15 56	12 41	0 36
26	12 45	13 10	5 36	2 22	3 09	2 39	6 15	1 29	8 55	16 01	12 22	1 06
27	12 57	13 00	5 17	2 32	3 02	2 51	6 14	1 12	9 15	16 07	12 02	1 35
28	13 09	12 49	4 59	2 41	2 55	3 03	6 13	0 54	9 35	16 11	11 41	2 05
29	13 20	12 37	4 40	2 50	2 47	3 15	6 11	0 36	9 54	16 15	11 19	2 34
30	13 30	12 25	4 22	2 58	2 39	3 27	6 09	**0 18**	10 14	16 17	10 57	3 03
31	13 39		4 04	3 05	2 31	3 38	6 06	0 00	10 33	16 19	10 34	3 32

EQUATION OF TIME FOR THE YEARS 1889, 1893, 1897, 1901.

Days.	JAN.	FEB.	MAR.	APR.	MAY.	JUNE.	JULY.	AUG.	SEPT.	OCT.	NOV.	DEC.
	Add to app. time.	Add to app. time.	Add to app. time.	Add to / Sub. from app. time.	Sub. from app. time.	Sub. from / Add to app. time.	Add to app. time.	Add to app. time.	Sub. from app. time.	Sub. from app. time.	Sub. from app. time.	Sub. from / Add to app. time.
	M. S.	M. S.	M. S.	M. S.	M. S.	M. S.	M. S.	M. S.	M. S.	M. S.	M. S.	M. S.
1	4 01	13 54	12 28	3 50	3 03	2 24	3 36	6 04	0 13	10 27	16 19	10 39
2	4 29	14 01	12 16	3 32	3 10	2 14	3 48	6 00	0 32	10 46	16 20	10 16
3	4 56	14 07	12 03	3 14	3 17	2 04	3 59	5 55	0 52	11 04	16 20	9 52
4	5 24	14 13	11 50	2 57	3 23	1 54	4 10	5 50	1 11	11 22	16 19	9 28
5	5 51	14 18	11 36	2 39	3 28	1 44	4 20	5 44	1 31	11 40	16 17	9 03
6	6 17	14 22	11 22	2 22	3 33	1 33	4 30	5 38	1 51	11 58	16 14	8 38
7	6 43	14 25	11 08	2 05	3 37	1 22	4 40	5 31	2 12	12 15	16 11	8 12
8	7 09	14 27	10 53	1 48	3 41	1 11	4 49	5 23	2 32	12 32	16 07	7 45
9	7 33	14 28	10 37	1 31	3 44	0 59	4 58	5 15	2 53	12 48	16 02	7 19
10	7 58	14 29	10 22	1 15	3 46	0 48	5 07	5 06	3 14	13 04	15 56	6 51
11	8 21	14 29	10 06	0 58	3 48	0 36	5 15	4 56	3 34	13 19	15 49	6 24
12	8 45	14 28	9 49	0 42	3 50	0 24	5 22	4 46	3 56	13 34	15 41	5 55
13	9 07	14 26	9 33	0 27	3 51	**0 11**	5 29	4 36	4 17	13 48	15 33	5 27
14	9 29	14 24	9 16	**0 12**	3 51	0 01	5 36	4 25	4 38	14 02	15 23	4 58
15	9 50	14 21	8 59	0 03	3 51	0 14	5 42	4 13	4 59	14 15	15 13	4 29
16	0 10	14 17	8 41	0 18	3 50	0 27	5 48	4 01	5 20	14 28	15 02	4 00
17	10 30	14 12	8 23	0 32	3 49	0 39	5 53	3 48	5 41	14 40	14 50	3 30
18	10 49	14 07	8 06	0 46	3 47	0 52	5 58	3 35	6 03	14 52	14 37	3 01
19	11 07	14 01	7 48	1 00	3 44	1 05	6 02	3 22	6 24	15 02	14 23	2 31
20	11 24	13 54	7 30	1 12	3 41	1 18	6 05	3 07	6 45	15 12	14 09	2 01
21	11 41	13 47	7 12	1 25	3 37	1 31	6 08	2 53	7 06	15 22	13 54	1 31
22	11 57	13 39	6 53	1 37	3 33	1 44	6 11	2 38	7 27	15 31	13 38	1 01
23	12 12	13 31	6 35	1 49	3 29	1 57	6 13	2 23	7 47	15 39	13 21	0 31
24	12 27	13 22	6 17	2 00	3 23	2 10	6 14	2 07	8 08	15 46	13 03	0 01
25	12 40	13 12	5 58	2 10	3 17	2 23	6 15	1 51	8 28	15 53	12 45	0 29
26	12 53	13 02	5 40	2 21	3 11	2 36	6 15	1 34	8 49	15 59	12 25	0 59
27	13 05	12 51	5 21	2 30	3 04	2 48	6 15	1 17	9 09	16 04	12 05	1 29
28	13 17	12 40	5 06	2 39	2 57	3 00	6 14	1 00	9 29	16 09	11 45	1 58
29	13 27	12 28	4 45	2 48	2 49	3 13	6 12	0 42	9 48	16 12	11 24	2 28
30	13 37		4 26	2 56	2 41	3 25	6 10	0 24	10 08	16 15	11 02	2 57
31	13 46		4 08		2 33		6 07	0 05		16 18	10 39	3 25

TABLE IV*a*.

CORRECTION TO BE APPLIED TO EQUATION OF TIME.

Hour.	′ 1	″ 2	″ 3	″ 4	″ 5	″ 6	″ 7	″ 8	″ 9	″ 10	″ 11	″ 12	″ 13	″ 14	″ 15	″ 16	″ 17	″ 18	″ 19	″ 20	″ 21	″ 22	″ 23	″ 24	″ 25	″ 26	″ 27	″ 28	″ 29	″ 30
1	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	3
3	0	0	0	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	4	4	4
4	0	0	1	1	1	1	1	1	2	2	2	2	2	2	3	3	3	3	3	3	4	4	4	4	4	4	5	5	5	5
5	0	0	1	1	1	1	1	2	2	2	2	3	3	3	3	3	4	4	4	4	4	5	5	5	5	5	6	6	6	6
6	0	1	1	1	1	2	2	2	2	3	3	3	3	4	4	4	4	5	5	5	5	6	6	6	6	7	7	7	7	8
7	0	1	1	1	1	2	2	2	3	3	3	4	4	4	5	5	5	6	6	6	7	7	7	8	8	8	8	8	8	9
8	0	1	1	1	2	2	2	3	3	3	4	4	4	5	5	5	6	6	6	7	7	7	8	8	8	9	9	9	10	10
9	0	1	1	2	2	2	3	3	3	4	4	5	5	5	6	6	6	7	7	8	8	8	9	9	9	10	10	11	11	11
10	0	1	1	2	2	3	3	3	4	4	5	5	5	6	6	7	7	8	8	8	9	9	10	10	10	11	11	12	12	13
11	0	1	1	2	2	3	3	4	4	5	5	6	6	6	7	7	8	8	9	9	10	10	11	11	11	12	12	13	13	14
12	1	1	2	2	3	3	4	4	5	5	6	6	7	7	8	8	9	9	10	10	11	11	12	12	13	13	14	14	15	15
13	1	1	2	2	3	3	4	4	5	5	6	7	7	8	8	9	9	10	10	11	11	12	12	13	14	14	15	15	16	16
14	1	1	2	2	3	4	4	5	5	6	6	7	8	8	9	9	10	11	11	12	12	13	13	14	15	15	16	16	17	18
15	1	1	2	3	3	4	4	5	6	6	7	8	8	9	9	10	11	11	12	13	13	14	14	15	16	16	17	18	18	19
16	1	1	2	3	3	4	4	5	5	6	7	7	8	9	9	10	11	11	12	13	14	15	15	16	17	17	18	19	19	20
17	1	1	2	3	4	4	5	6	6	7	8	9	9	10	11	11	12	13	13	14	15	16	16	17	18	18	19	20	21	21
18	1	2	2	3	4	5	5	6	7	8	8	9	10	11	11	12	13	14	14	15	16	17	17	18	19	20	20	21	22	23
19	1	2	2	3	4	5	6	6	7	8	9	10	10	11	12	13	13	14	15	16	17	17	18	19	20	21	21	22	23	24
20	1	2	3	3	4	5	6	7	8	8	9	10	11	12	13	13	14	15	16	17	18	18	19	20	21	22	23	23	24	25
21	1	2	3	4	4	5	6	7	8	9	10	11	11	12	13	14	15	16	17	18	18	19	20	21	22	23	24	25	25	26
22	1	2	3	4	5	6	6	7	8	9	10	11	12	13	14	15	16	17	17	18	19	20	21	22	23	24	25	26	27	28
23	1	2	3	4	5	6	7	8	9	10	11	12	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
24	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30

TABLE V.

SINES, TANGENTS, AND SECANTS.

SINES, TANGENTS, AND SECANTS.

0° 170°

M.	Hour A. M.	Hour P. M.	Sine.	Diff. 1′.	Cosecant.	Tangent.	Diff. 1′.	Cotangent.	Secant.	Cosine.	M.
0	12 0 0	0 0 0	Inf. neg.		Infinite.	Inf. neg.		Infinite.	10. 00000	10. 00000	60
1	11 59 52	0 0 8	6. 46373	30103	13. 53627	6. 46373	30103	13. 53627	00000	00000	59
2	59 44	0 16	76476	17609	23524	76476	17609	23524	00000	00000	58
3	59 36	0 24	94085	12494	05915	94085	12494	05915	00000	00000	57
4	59 28	0 32	7. 06579	9691	12. 93421	7. 06579	9691	12. 93421	00000	00000	56
5	11 59 20	0 0 40	7. 16270	7918	12. 83730	7. 16270	7918	12. 83730	10. 00000	10. 00000	55
6	59 12	0 48	24188	6694	75812	24188	6694	75812	00000	00000	54
7	59 4	0 56	30882	5800	69118	30882	5800	69118	00000	00000	53
8	58 56	1 4	36682	5115	63318	36682	5115	63318	00000	00000	52
9	58 48	1 12	41797	4576	58203	41797	4576	58203	00000	00000	51
10	11 58 40	0 1 20	7. 46373	4139	12. 53627	7. 46373	4139	12. 53627	10. 00000	10. 00000	50
11	58 32	1 28	50512	3779	49488	50512	3779	49488	00000	00000	49
12	58 24	1 36	54291	3476	45709	54291	3476	45709	00000	00000	48
13	58 16	1 44	57767	3218	42233	57767	3219	42233	00000	00000	47
14	58 8	1 52	60986	2997	39015	60986	2996	39014	00000	00000	46
15	11 58 0	0 2 0	7. 63982	2802	12. 36018	7. 63982	2803	12. 36018	10. 00000	10. 00000	45
16	57 52	2 8	66784	2633	33216	66785	2633	33215	00000	00000	44
17	57 44	2 16	69417	2483	30583	69418	2482	30582	00001	9. 99999	43
18	57 36	2 24	71900	2348	28100	71900	2348	28100	00001	99999	42
19	57 28	2 32	74248	2227	25752	74248	2228	25752	00001	99999	41
20	11 57 20	0 2 40	7. 76475	2119	12. 23525	7. 76476	2119	12. 23524	10. 00001	9. 99999	40
21	57 12	2 48	78594	2021	21406	78595	2020	21405	00001	99999	39
22	57 4	2 56	80615	1930	19385	80615	1931	19385	00001	99999	38
23	56 56	3 4	82545	1848	17455	82546	1848	17454	00001	99999	37
24	56 48	3 12	84393	1773	15607	84394	1773	15606	00001	99999	36
25	11 56 40	0 3 20	7. 86166	1704	12. 13834	7. 86167	1704	12. 13833	10. 00001	9. 99999	35
26	56 32	3 28	87870	1639	12130	87871	1639	12129	00001	99999	34
27	56 24	3 36	89509	1579	10491	89510	1579	10490	00001	99999	33
28	56 16	3 44	91088	1524	08912	91089	1524	08911	00001	99999	32
29	56 8	3 52	92612	1472	07388	92613	1473	07387	00002	99998	31
30	11 56 0	0 4 0	7. 94084	1424	12. 05916	7. 94086	1424	12. 05914	10. 00002	9. 99998	30
31	55 52	4 8	95508	1379	04492	95510	1379	04490	00002	99998	29
32	55 44	4 16	96887	1336	03113	96889	1336	03111	00002	99998	28
33	55 36	4 24	98223	1297	01777	98225	1297	01775	00002	99998	27
34	55 28	4 32	99520	1259	00480	99522	1259	00478	00002	99998	26
35	11 55 20	0 4 40	8. 00779	1223	11. 99221	8. 00781	1223	11. 99219	10. 00002	9. 99998	25
36	55 12	4 48	02002	1190	97998	02004	1190	97996	00002	99998	24
37	55 4	4 56	03192	1158	96808	03194	1159	96806	00003	99997	23
38	54 56	5 4	04350	1128	95650	04353	1128	95647	00003	99997	22
39	54 48	5 12	05478	1100	94522	05481	1100	94519	00003	99997	21
40	11 54 40	0 5 20	8. 06578	1072	11. 93422	8. 06581	1072	11. 93419	10. 00003	9. 99997	20
41	54 32	5 28	07650	1046	92350	07653	1047	92347	00003	99997	19
42	54 24	5 36	08696	1022	91304	08700	1022	91300	00003	99997	18
43	54 16	5 44	09718	999	90282	09722	998	90278	00003	99997	17
44	54 8	5 52	10717	976	89283	10720	976	89280	00004	99996	16
45	11 54 0	0 6 0	8. 11693	954	11. 88307	8. 11696	955	11. 88304	10. 00004	9. 99996	15
46	53 52	6 8	12647	934	87353	12651	934	87349	00004	99996	14
47	53 44	6 16	13581	914	86419	13585	915	86415	00004	99996	13
48	53 36	6 24	14495	896	85505	14500	895	85500	00004	99996	12
49	53 28	6 32	15391	877	84609	15395	878	84605	00004	99996	11
50	11 53 20	0 6 40	8. 16268	860	11. 83732	8. 16273	860	11. 83727	10. 00005	99995	10
51	53 12	6 48	17128	843	82872	17133	843	82867	00005	99995	9
52	53 4	6 56	17971	827	82029	17976	828	82024	00005	99995	8
53	52 56	7 4	18798	812	81202	18804	812	81196	00005	99995	7
54	52 48	7 12	19610	797	80390	19616	797	80384	00005	99995	6
55	11 52 40	0 7 20	8. 20407	782	11. 79593	8. 20413	782	11. 79587	10. 00006	9. 99994	5
56	52 32	7 28	21189	769	78811	21195	769	78805	00006	99994	4
57	52 24	7 36	21958	755	78042	21964	756	78036	00006	99994	3
58	52 16	7 44	22713	743	77287	22720	742	77280	00006	99994	2
59	52 8	7 52	23456	730	76544	23462	730	76538	00006	99994	1
60	52 0	8 0	24186	717	75814	24192	718	75808	00007	99993	0
M.	Hour P. M.	Hour A. M.	Cosine.	Diff. 1′.	Secant.	Cotangent.	Diff. 1′.	Tangent.	Cosecant.	Sine.	M.

90° 89°

1° 178°

M.	Hour A. M.	Hour P. M.	Sine.	Diff. 1′.	Cosecant.	Tangent.	Diff. 1′.	Cotangent	Secant.	Cosine.	M.
0	11 52 0	0 8 0	8. 24186	717	11. 75814	8. 24192	718	11. 75808	10. 00007	9. 99993	60
1	51 52	8 8	24903	706	75097	24910	706	75090	00007	99993	59
2	51 44	8 16	25609	695	74391	25616	696	74384	00007	99993	58
3	51 36	8 24	26304	684	73696	26312	684	73688	00007	99993	57
4	51 28	8 32	26988	673	73012	26996	673	73004	00008	99992	56
5	11 51 20	0 8 40	8. 27661	663	11. 72339	8. 27669	663	11. 72331	10. 00008	9. 99992	55
6	51 12	8 48	28324	653	71676	28332	654	71668	00008	99992	54
7	51 4	8 56	28977	644	71023	28986	643	71014	00008	99992	53
8	50 56	9 4	29621	634	70379	29629	634	70371	00008	99992	52
9	50 48	9 12	30255	624	69745	30263	625	69737	00009	99991	51
10	11 50 40	0 9 20	8. 30879	616	11. 69121	8. 30888	617	11. 69112	10. 00009	9. 99991	50
11	50 32	9 28	31495	608	68505	31505	607	68495	00009	99991	49
12	50 24	9 36	32103	599	67897	32112	599	67888	00010	99990	48
13	50 16	9 44	32702	590	67298	32711	591	67289	00010	99990	47
14	50 8	9 52	33292	583	66708	33302	584	66698	00010	99990	46
15	11 50 0	0 10 0	8. 33875	575	11. 66125	8. 33886	575	11. 66114	10. 00010	99990	45
16	49 52	10 8	34450	568	65550	34461	568	65539	00011	99989	44
17	49 44	10 16	35018	560	64982	35029	561	64971	00011	99989	43
18	49 36	10 24	35578	553	64422	35590	553	64410	00011	99989	42
19	49 28	10 32	36131	547	63869	36143	546	63857	00011	99989	41
20	11 49 20	0 10 40	8. 36678	539	11. 63322	8. 36689	540	11. 63311	10. 00012	9. 99988	40
21	49 12	10 48	37217	533	62783	37229	533	62771	00012	99988	39
22	49 4	10 56	37750	526	62250	37762	587	62238	00012	99988	38
23	48 56	11 4	38276	520	61724	38289	520	61711	00013	99987	37
24	48 48	11 12	38796	514	61204	38809	514	61191	00013	99987	36
25	11 48 40	0 11 20	8. 39310	508	11. 60690	8. 39323	509	11. 60677	10. 00013	9. 99987	35
26	48 32	11 28	39818	502	60182	39832	502	60168	00014	99986	34
27	48 24	11 36	40320	196	59680	40334	496	59666	00014	99986	33
28	48 16	11 44	40816	191	59184	40830	491	59170	00014	99986	32
29	48 8	11 52	41307	485	58693	41321	486	58679	00015	99985	31
30	11 48 0	0 12 0	8. 41792	480	11. 58208	8. 41807	480	11. 58193	10. 00015	9. 99985	30
31	47 52	12 8	42272	474	57728	42287	475	57713	00015	99985	29
32	47 44	12 16	42746	470	57254	42762	470	57238	00016	99984	28
33	47 36	12 24	43216	464	56784	43232	464	56768	00016	99984	27
34	47 28	12 32	43680	459	56320	43696	460	56304	00016	99984	26
35	11 47 20	0 12 40	8. 44139	455	11. 55861	8. 44156	455	11. 55844	10. 00017	9. 99983	25
36	47 12	12 48	44594	450	55406	44611	450	55389	00017	99983	24
37	47 4	12 56	45044	445	54956	45061	446	54939	00017	99983	23
38	46 56	13 4	45489	441	54511	45507	441	54493	00018	99982	22
39	46 48	13 12	45930	436	54070	45948	437	54052	00018	99982	21
40	11 46 40	0 13 20	8. 46366	433	11. 53634	8. 46385	432	11. 53615	10. 00018	9. 99982	20
41	46 32	13 28	46799	427	53201	46817	428	53183	00019	99981	19
42	46 24	13 36	47226	424	52774	47245	424	52755	00019	99981	18
43	46 16	13 44	47650	419	52350	47669	420	52331	00019	99981	17
44	46 8	13 52	48069	416	51931	48089	416	51911	00020	99980	16
45	11 46 0	0 14 0	8. 48485	411	11. 51515	8. 48505	412	11. 51495	10. 00020	9. 99980	15
46	45 52	14 8	48896	408	51104	48917	408	51083	00021	99979	14
47	45 44	14 16	49304	404	50696	49325	404	50675	00021	99979	13
48	45 36	14 24	49708	400	50292	49729	401	50271	00021	99979	12
49	45 28	14 32	50108	396	49892	50130	397	49870	00022	99978	11
50	11 45 20	0 14 40	8. 50504	393	11. 49496	8. 50527	393	11. 49473	10. 00022	9. 99978	10
51	45 12	14 48	50897	390	49103	50920	390	49080	00023	99977	9
52	45 4	14 56	51287	386	48713	51310	386	48690	00023	99977	8
53	44 56	15 4	51673	382	48327	51696	383	48304	00023	99977	7
54	44 48	15 12	52055	370	47945	52079	380	47921	00024	99976	6
55	11 44 40	0 15 20	8. 52434	376	11. 47566	8. 52459	376	11. 47541	10. 00024	9. 99976	5
56	44 32	15 28	52810	373	47190	52835	373	47165	00025	99975	4
57	44 24	15 36	53183	369	46817	53208	370	46792	00025	99975	3
58	44 16	15 44	53552	367	46448	53578	367	46422	00026	99974	2
59	44 8	15 52	53919	363	46081	53945	363	46055	00026	99974	1
60	44 0	16 0	54282	360	45718	54308	361	45692	00026	99974	0
M.	Hour P. M.	Hour A. M.	Cosine.	Diff. 1′.	Secant.	Cotangent.	Diff. 1′.	Tangent.	Cosecant.	Sine.	M.

91° 88°

SINES, TANGENTS, AND SECANTS.

M.	Hour A. M.	Hour P. M.	Sine.	Diff. 1′.	Cosecant.	Tangent.	Diff. 1′.	Cotangent.	Secant	Cosine	M.
0	11 44 0	0 16 0	8. 54282	360	11. 45718	8. 54308	361	11. 45692	10. 00026	9 99974	60
1	43 52	16 8	54642	357	45358	54669	358	45331	00027	99973	59
2	43 44	16 16	54999	355	45001	55027	355	44973	00027	99973	58
3	43 36	16 24	55354	351	44646	55382	352	44618	00028	99972	57
4	43 28	16 32	55705	349	44295	55734	349	44266	00028	99972	56
5	11 43 20	0 16 40	8. 56054	346	11. 43946	8. 56083	346	11. 43917	10. 00029	9. 99971	55
6	43 12	16 48	56400	343	43600	56429	344	43571	00029	99971	54
7	43 4	16 56	56743	341	43257	56773	341	43227	00030	99970	53
8	42 56	17 4	57084	337	42916	57114	338	42886	00030	99970	52
9	42 48	17 12	57421	336	42579	57452	336	42548	00031	99969	51
10	11 42 40	0 17 20	8. 57757	332	11. 42243	8. 57788	333	11. 42212	10. 00031	9. 99969	50
11	42 32	17 28	58089	330	41911	58121	330	41879	00032	99968	49
12	42 24	17 36	58419	328	41581	58451	328	41549	00032	99968	48
13	42 16	17 44	58747	325	41253	58779	326	41221	00033	99967	47
14	42 8	17 52	59072	323	40928	59105	323	40895	00033	99967	46
15	11 42 0	0 18 0	8. 59395	320	11. 40605	8. 59428	321	11. 40572	10. 00033	9. 99967	45
16	41 52	18 8	59715	318	40285	59749	319	40251	00034	99966	44
17	41 44	18 16	60033	316	39967	60068	316	39932	00034	99966	43
18	41 36	18 24	60349	313	39651	60384	314	39616	00035	99965	42
19	41 28	18 32	60662	311	39338	60698	311	39302	00036	99964	41
20	11 41 20	0 18 40	8. 60973	309	11. 39027	8. 61009	310	11. 38991	10. 00036	9. 99964	40
21	41 12	18 48	61282	307	38718	61319	307	38681	00037	99963	39
22	41 4	18 56	61589	305	38411	61626	305	38374	00037	99963	38
23	40 56	19 4	61894	302	38106	61931	303	38069	00038	99962	37
24	40 48	19 12	62196	301	37804	62234	301	37766	00038	99962	36
25	11 40 40	0 19 20	8. 62497	298	11. 37503	8. 62535	299	11. 37465	10. 00039	9. 99961	35
26	40 32	19 28	62795	296	37205	62834	297	37166	00039	99961	34
27	40 24	19 36	63091	294	36909	63131	295	36869	00040	99960	33
28	40 16	19 44	63385	293	36615	63426	292	36574	00040	99960	32
29	40 8	19 52	63678	290	36322	63718	291	36282	00041	99959	31
30	11 40 0	0 20 0	8. 63968	288	11. 36032	8. 64009	289	11. 35991	10. 00041	9. 99959	30
31	39 52	20 8	64256	287	35744	64298	287	35702	00042	99958	29
32	39 44	20 16	64543	284	35457	64585	285	35415	00042	99958	28
33	39 36	20 24	64827	283	35173	64870	284	35130	00043	99957	27
34	39 28	20 32	65110	281	34890	65154	281	34846	00044	99956	26
35	11 39 20	0 20 40	8. 65391	279	11. 34609	8. 65435	280	11. 34565	10. 00044	9. 99956	25
36	39 12	20 48	65670	277	34330	65715	278	34285	00045	99955	24
37	39 4	20 56	65947	276	34053	65993	276	34007	00045	99955	23
38	38 56	21 4	66223	274	33777	66269	274	33731	00046	99954	22
39	38 48	21 12	66497	272	33503	66543	273	33457	00046	99954	21
40	11 38 40	0 21 20	8. 66769	270	11. 33231	8. 66816	271	11. 33184	10. 00047	9. 99953	20
41	38 32	21 28	67039	269	32961	67087	269	32913	00048	99952	19
42	38 24	21 36	67308	267	32692	67356	268	32644	00048	99952	18
43	38 16	21 44	67575	266	32425	67624	266	32376	00049	99951	17
44	38 8	21 52	67841	263	32159	67890	264	32110	00049	99951	16
45	11 38 0	0 22 0	8. 68104	263	11. 31896	8. 68154	263	11. 31846	10. 00050	9. 99950	15
46	37 52	22 8	68367	260	31633	68417	261	31583	00051	99949	14
47	37 44	22 16	68627	259	31373	68678	260	31322	00051	99949	13
48	37 36	22 24	68886	258	31114	68938	258	31062	00052	99948	12
49	37 28	22 32	69144	256	30856	69196	257	30804	00052	99948	11
50	11 37 20	0 22 40	8. 69400	254	11. 30600	8. 69453	255	11. 30547	10. 00053	9. 99947	10
51	37 12	22 48	69654	253	30346	69708	254	30292	00054	99946	9
52	37 4	22 56	69907	252	30093	69962	252	30038	00054	99946	8
53	36 56	23 4	70159	250	29841	70214	251	29786	00055	99945	7
54	36 48	23 12	70409	249	29591	70465	249	29535	00056	99944	6
55	11 36 40	0 23 20	8. 70658	247	11. 29342	8. 70714	248	11. 29286	10. 00056	9. 99944	5
56	36 32	23 28	70905	246	29095	70962	246	29038	00057	99943	4
57	36 24	23 36	71151	244	28849	71208	245	28792	00058	99942	3
58	36 16	23 44	71395	243	28605	71453	244	28547	00058	99942	2
59	36 8	23 52	71638	242	28362	71697	243	28303	00059	99941	1
60	36 0	24 0	71880	240	28120	71940	241	28060	00060	99940	0
M.	Hour P. M.	Hour A. M.	Cosine.	Diff. 1′.	Secant.	Cotangent.	Diff. 1′.	Tangent.	Cosecant.	Sine.	M.

SINES, TANGENTS, AND SECANTS.

3°										176°
M.	Hour A. M.	Hour P. M.	Sine.	Diff. 1'.	Cosecant.	Tangent.	Diff. 1'.	Cotangent.	Secant.	Cosine.	M.
0	11 36 0	0 24 0	8. 71880	240	11. 28120	8. 71940	241	11. 28060	10. 00060	9. 99940	60
1	35 52	24 8	72120	239	27880	72181	239	27819	00060	99940	59
2	35 44	24 16	72359	238	27641	72420	239	27580	00061	99939	58
3	35 36	24 24	72597	237	27403	72659	237	27341	00062	99938	57
4	35 28	24 32	72834	235	27166	72896	236	27104	00062	99938	56
5	11 35 20	0 24 40	8. 73069	234	11. 26931	8. 73132	234	11. 26868	10. 00063	9. 99937	55
6	35 12	24 48	73303	232	26697	73366	234	26634	00064	99936	54
7	35 4	24 56	73535	232	26465	73600	232	26400	00064	99936	53
8	34 56	25 4	73767	230	26233	73832	231	26168	00065	99935	52
9	34 48	25 12	73997	229	26003	74063	229	25937	00066	99934	51
10	11 34 40	0 25 20	8. 74226	228	11. 25774	8. 74292	229	11. 25708	10. 00066	9. 99934	50
11	34 32	25 28	74454	226	25546	74521	227	25479	00067	99933	49
12	34 24	25 36	74680	226	25320	74748	226	25252	00068	99932	48
13	34 16	25 44	74906	224	25094	74974	225	25026	00068	99932	47
14	34 8	25 52	75130	223	24870	75199	224	24801	00069	99931	46
15	11 34 0	0 26 0	8. 75353	222	11. 24647	8. 75423	222	11. 24577	10. 00070	9. 99930	45
16	33 52	26 8	75575	220	24425	75645	222	24355	00071	99929	44
17	33 44	26 16	75795	220	24205	75867	220	24133	00071	99929	43
18	33 36	26 44	76015	219	23985	76087	219	23913	00072	99928	42
19	33 28	26 32	76234	217	23766	76306	219	23694	00073	99927	41
20	11 33 20	0 26 40	8. 76451	216	11. 23549	8. 76525	217	11. 23475	10. 00074	9. 99926	40
21	33 12	26 48	76667	216	23333	76742	216	23258	00074	99926	39
22	33 4	26 56	76883	214	23117	76958	215	23042	00075	99925	38
23	32 56	27 4	77097	213	22903	77173	214	22827	00076	99924	37
24	32 48	27 12	77310	212	22690	77387	213	22613	00077	99923	36
25	11 32 40	0 27 20	8. 77522	211	11. 22478	8. 77600	211	11. 22400	10. 00077	9. 99923	35
26	32 32	27 28	77733	210	22267	77811	211	22189	00078	99922	34
27	32 24	27 36	77943	209	22057	78022	210	21978	00079	99921	33
28	32 16	27 44	78152	208	21848	78232	209	21768	00080	99920	32
29	32 8	27 52	78360	208	21640	78441	208	21559	00080	99920	31
30	11 32 0	0 28 0	8. 78568	206	11. 21432	8. 78649	206	11. 21351	10. 00081	9. 99919	30
31	31 52	28 8	78774	205	21226	78855	206	21145	00082	99918	29
32	31 44	28 16	78979	204	21021	79061	205	20939	00083	99917	28
33	31 36	28 24	79183	203	20817	79266	204	20734	00083	99917	27
34	31 28	28 32	79386	202	20614	79470	203	20530	00084	99916	26
35	11 31 20	0 28 40	8. 79588	201	11. 20412	8. 79673	202	11. 20327	10. 00085	9. 99915	25
36	31 12	28 48	79789	201	20211	79875	201	20125	00086	99914	24
37	31 4	28 56	79990	199	20010	80076	201	19924	00087	99913	23
38	30 56	29 4	80189	199	19811	80277	199	19723	00087	99913	22
39	30 48	29 12	80388	197	19612	80476	198	19524	00088	99912	21
40	11 30 40	0 29 20	8. 80585	197	11. 19415	8. 80674	198	11. 19326	10. 00089	9. 99911	20
41	30 32	29 28	80782	196	19218	80872	196	19128	00090	99910	19
42	30 24	29 36	80978	195	19022	81068	196	18932	00091	99909	18
43	30 16	29 44	81173	194	18827	81264	195	18736	00091	99909	17
44	30 8	29 52	81367	193	18633	81459	194	18541	00092	99908	16
45	11 30 0	0 30 0	8. 81560	192	11. 18440	8. 81653	193	11. 18347	10. 00093	9. 99907	15
46	29 52	30 8	81752	192	18248	81846	193	18154	00094	99906	14
47	29 44	30 16	81944	190	18056	82038	192	17962	00095	99905	13
48	29 36	30 24	82134	190	17866	82230	190	17770	00096	99904	12
49	29 28	30 32	82324	189	17676	82420	190	17580	00096	99904	11
50	11 29 20	0 30 40	8. 82513	188	11. 17487	8. 82610	189	11. 17390	10. 00097	9. 99903	10
51	29 12	30 48	82701	187	17299	82799	188	17201	00098	99902	9
52	29 4	30 56	82888	187	17112	82987	188	17013	00099	99901	8
53	28 56	31 4	83075	186	16925	83175	186	16825	00100	99900	7
54	28 48	31 12	83261	185	16739	83361	186	16639	00101	99899	6
55	11 28 40	0 31 20	8. 83446	184	11. 16554	8. 83547	185	11. 16453	10. 00102	9. 99898	5
56	28 32	31 28	83630	183	16370	83732	184	16268	00102	99898	4
57	28 24	31 36	83813	183	16187	83916	184	16084	00103	99897	3
58	28 16	31 44	83996	181	16004	84100	182	15900	00104	99896	2
59	28 8	31 52	84177	181	15823	84282	182	15718	00104	99895	1
60	28 0	32 0	84358	181	15642	84464	182	15536	00105	99894	0
M.	Hour P. M.	Hour A. M.	Cosine.	Diff. 1'.	Secant.	Cotangent.	Diff. 1'	Tangent.	Cosecant.	Sine.	M.
93°											86°

4° 175°

M.	Hour A. M.	Hour P. M.	Sine.	Diff. 1'.	Cosecant.	Tangent.	Diff. 1'.	Cotangent.	Secant.	Cosine.	M.
0	11 28 0	0 32 0	8. 84358	181	11. 15642	8. 84464	182	11. 15536	10. 00106	9. 99894	60
1	27 52	32 8	84539	179	15461	84646	180	15354	00107	99893	59
2	27 44	32 16	84718	179	15282	84826	180	15174	00108	99892	58
3	27 36	32 24	84897	178	15103	85006	179	14994	00109	99891	57
4	27 28	32 32	85075	177	14925	85185	178	14815	00109	99891	56
5	11 27 20	0 32 40	8. 85252	177	11. 14748	8. 85363	177	11. 14637	10. 00110	9. 99890	55
6	27 12	32 48	85429	176	14571	85540	177	14460	00111	99889	54
7	27 4	32 56	85605	175	14395	85717	176	14283	00112	99888	53
8	26 56	33 4	85780	175	14220	85893	176	14107	00113	99887	52
9	26 48	33 12	85955	173	14045	86069	174	13931	00114	99886	51
10	11 26 40	0 33 20	8. 86128	173	11. 13872	8. 86243	174	11. 13757	10. 00115	9. 99885	50
11	26 32	33 28	86301	173	13699	86417	174	13583	00116	99884	49
12	26 24	33 36	86474	171	13526	86591	172	13409	00117	99883	48
13	26 16	33 44	86645	171	13355	86763	172	13237	00118	99882	47
14	26 8	33 52	86816	171	13184	86935	171	13065	00119	99881	46
15	11 26 0	34 0	8. 86987	169	11. 13013	8. 87106	171	11. 12894	10. 00120	9. 99880	45
16	25 52	34 8	87156	169	12844	87277	170	12723	00121	99879	44
17	25 44	34 16	87325	169	12675	87447	169	12553	00121	99879	43
18	25 36	34 24	87494	167	12506	87616	169	12384	00122	99878	42
19	25 28	34 32	87661	168	12339	87785	168	12215	00123	99877	41
20	11 25 20	0 34 40	8. 87829	166	11. 12171	8. 87953	167	11. 12047	10. 00124	9. 99876	40
21	25 12	34 48	87995	166	12005	88120	167	11880	00125	99875	39
22	25 4	34 56	88161	165	11839	88287	166	11713	00126	99874	38
23	24 56	35 4	88326	164	11674	88453	165	11547	00127	99873	37
24	24 48	35 12	88490	164	11510	88618	165	11382	00128	99872	36
25	11 24 40	0 35 20	8. 88654	163	11. 11346	8. 88783	165	11. 11217	10. 00129	9. 99871	35
26	24 32	35 28	88817	163	11183	88948	163	11052	00130	99870	34
27	24 24	35 36	88980	162	11020	89111	163	10889	00131	99869	33
28	24 16	35 44	89142	162	10858	89274	163	10726	00132	99868	32
29	24 8	35 52	89304	160	10696	89437	161	10563	00133	99867	31
30	11 24 0	0 36 0	8. 89464	161	11. 10536	8. 89598	161	11. 10402	10. 00134	9. 99866	30
31	23 52	36 8	89625	159	10375	89760	160	10240	00135	99865	29
32	23 44	36 16	89784	159	10216	89920	160	10080	00136	99864	28
33	23 36	36 24	89943	159	10057	90080	160	09920	00137	99863	27
34	23 28	36 32	90102	158	09898	90240	159	09760	00138	99862	26
35	11 23 20	0 36 40	8. 90260	157	11. 09740	8. 90399	159	11. 09601	10. 00139	9. 99861	25
36	23 12	36 48	90417	157	09583	90557	158	09443	00140	99860	24
37	23 4	36 56	90574	156	09426	90715	157	09285	00141	99859	23
38	22 56	37 4	90730	155	09270	90872	157	09128	00142	99858	22
39	22 48	37 12	90885	155	09115	91029	156	08971	00143	99857	21
40	11 22 40	0 37 20	8. 91040	155	11. 08960	8. 91185	155	11. 08815	10. 00144	9. 99856	20
41	22 32	37 28	91195	154	08805	91340	155	08660	00145	99855	19
42	22 24	37 36	91349	153	08651	91495	155	08505	00146	99854	18
43	22 16	37 44	91502	153	08498	91650	153	08350	00147	99853	17
44	22 8	37 52	91655	152	08345	91803	154	08197	00148	99852	16
45	11 22 0	0 38 0	8. 91807	152	11. 08193	8. 91957	153	11. 08043	10. 00149	9. 99851	15
46	21 52	38 8	91959	151	08041	92110	152	07890	00150	99850	14
47	21 44	38 16	92110	151	07890	92262	152	07738	00150	99848	13
48	21 36	38 24	92261	150	07739	92414	151	07586	00153	99847	12
49	21 28	38 32	92411	150	07589	92565	151	07435	00154	99846	11
50	11 21 20	0 38 40	8. 92561	149	11. 07439	8. 92716	150	11. 07284	10. 00155	9. 99845	10
51	21 12	38 48	92710	149	07290	92866	150	07134	00156	99844	9
52	21 4	38 56	92859	148	07141	93016	149	06984	00157	99843	8
53	20 56	39 4	93007	147	06993	93165	148	06835	00158	99842	7
54	20 48	39 12	93154	147	06846	93313	149	06687	00159	99841	6
55	11 20 40	0 39 20	8. 93301	147	11. 06699	8. 93462	147	11. 06538	10. 00160	9. 99840	5
56	20 32	39 28	93448	146	06552	93609	147	06391	00161	99839	4
57	20 24	39 36	93594	146	06406	93756	147	06244	00162	99838	3
58	20 16	39 44	93740	145	06260	93903	146	06097	00163	99837	2
59	20 8	39 52	93885	145	06115	94049	146	05951	00164	99836	1
60	20 0	40 0	94030	144	05970	94195	145	05805	00166	99834	0
M.	Hour P. M.	Hour A. M.	Coline.	Diff. 1'.	Secant.	Cotangent.	Diff. 1'.	Tangent.	Cosecant.	Sine.	M.

94° 85°

SINES, TANGENTS, AND SECANTS.

5° 171°

M.	Hour A. M.	Hour P. M.	Sine.	Diff.	Cosecant.	Tangent.	Diff.	Cotangent.	Secant.	Diff.	Cosine.	M.
0	11 20 00	0 40 0	8. 94030	0	11. 05970	8. 94195	0	11. 05805	10. 00166	0	9. 99834	60
1	19 52	40 8	94174	2	05826	94340	2	05660	00167	0	99833	59
2	19 44	40 16	94317	4	05683	94485	4	05515	00168	0	99832	58
3	19 36	40 24	94461	7	05539	94630	7	05370	00169	0	99831	57
4	19 28	40 32	94603	9	05397	94773	9	05227	00170	0	99830	56
5	11 19 20	0 40 40	8. 94746	11	11. 05254	8. 94917	11	11. 05083	10. 00171	0	9. 99829	55
6	19 12	40 48	94887	13	05113	95060	13	04940	00172	0	99828	54
7	19 4	40 56	95029	15	04971	95202	15	04798	00173	0	99827	53
8	18 56	41 4	95170	18	04830	95344	18	04656	00175	0	99825	52
9	18 48	41 12	95310	20	04690	95486	20	04514	00176	0	99824	51
10	11 18 40	0 41 20	8. 95450	22	11. 04550	8. 95627	22	11. 04373	10. 00177	0	9. 99823	50
11	18 32	41 28	95589	24	04411	95767	24	04233	00178	0	99822	49
12	18 24	41 36	95728	26	04272	95908	27	04092	00179	0	99821	48
13	18 16	41 44	95867	29	04133	96047	29	03953	00180	0	99820	47
14	18 8	41 52	96005	31	03995	96187	31	03813	00181	0	99819	46
15	11 18 0	0 42 0	8. 96143	33	11. 03857	8. 96325	33	11. 03675	10. 00183	0	9. 99817	45
16	17 52	42 8	96280	35	03720	96464	35	03536	00184	0	99816	44
17	17 44	42 16	96417	37	03583	96602	38	03398	00185	0	99815	43
18	17 36	42 24	96553	39	03447	96739	40	03261	00186	0	99814	42
19	17 28	42 32	96689	42	03311	96877	42	03123	00187	0	99813	41
20	11 17 20	0 42 40	8. 96825	44	11. 03175	8. 97013	44	11. 02987	10. 00188	0	9. 99812	40
21	17 12	42 48	96960	46	03040	97150	46	02850	00190	0	99810	39
22	17 4	42 56	97095	48	02905	97285	49	02715	00191	0	99809	38
23	16 56	43 4	97229	50	02771	97421	51	02579	00192	0	99808	37
24	16 48	43 12	97363	53	02637	97556	53	02444	00193	0	99807	36
25	11 16 40	0 43 20	8. 97496	55	11. 02504	8. 97691	55	11. 02309	10. 00194	1	9. 99806	35
26	16 32	43 28	97629	57	02371	97825	58	02175	00196	1	99804	34
27	16 24	43 36	97762	59	02238	97959	60	02041	00197	1	99803	33
28	16 16	43 44	97894	61	02106	98092	62	01908	00198	1	99802	32
29	16 8	43 52	98026	64	01974	98225	64	01775	00199	1	99801	31
30	11 16 0	0 44 0	8. 98157	66	11. 01843	8. 98358	66	11. 01642	10. 00200	1	9. 99800	30
31	15 52	44 8	98288	68	01712	98490	69	01510	00202	1	99798	29
32	15 44	44 16	98419	70	01581	98622	71	01378	00203	1	99797	28
33	15 36	44 24	98549	72	01451	98753	73	01247	00204	1	99796	27
34	15 28	44 32	98679	75	01321	98884	75	01116	00205	1	99795	26
35	11 15 20	0 44 40	8. 98808	77	11. 01192	8. 99015	77	11. 00985	10. 00207	1	9. 99793	25
36	15 12	44 48	98937	79	01063	99145	80	00855	00208	1	99792	24
37	15 4	44 56	99066	81	00934	99275	82	00725	00209	1	99791	23
38	14 56	45 4	99194	83	00806	99405	84	00595	00210	1	99790	22
39	14 48	45 12	99322	86	00678	99534	86	00466	00212	1	99788	21
40	11 14 40	0 45 20	8. 99450	88	11. 00550	8. 99662	89	11. 00338	10. 00213	1	9. 99787	20
41	14 32	45 28	99577	90	00423	99791	91	00209	00214	1	99786	19
42	14 24	45 36	99704	92	00296	99919	93	00081	00215	1	99785	18
43	14 16	45 44	99830	94	00170	9. 00046	95	10. 99954	00217	1	99783	17
44	14 8	45 52	99956	96	00044	00174	97	99826	00218	1	99782	16
45	11 14 0	0 46 0	9. 00082	99	10. 99918	9. 00301	100	10. 99699	10. 00219	1	9. 99781	15
46	13 52	46 8	00207	101	99793	00427	102	99573	00220	1	99780	14
47	13 44	46 16	00333	103	99668	00553	104	99447	00222	1	99778	13
48	13 36	46 24	00456	105	99544	00679	106	99321	00223	1	99777	12
49	13 28	46 32	00581	107	99419	00805	108	99195	00224	1	99776	11
50	11 13 20	0 46 40	9. 00704	110	10. 99296	9. 00930	111	10. 99070	10. 00225	1	9. 99775	10
51	13 12	46 48	00828	112	99172	01055	113	98945	00227	1	99773	9
52	13 4	46 56	00951	114	99049	01179	115	98821	00228	1	99772	8
53	12 56	47 4	01074	116	98926	01303	117	98697	00229	1	99771	7
54	12 48	47 12	01196	118	98804	01427	120	98573	00231	1	99769	6
55	11 12 40	0 47 20	9. 01318	121	10. 98682	9. 01550	122	10. 98450	10. 00232	1	9. 99768	5
56	12 32	47 28	01440	123	98560	01673	124	98327	00233	1	99767	4
57	12 24	47 36	01561	125	98439	01796	126	98204	00235	1	99765	3
58	12 16	47 44	01682	127	98318	01918	128	98082	00236	1	99764	2
59	12 8	47 52	01803	129	98197	02040	131	97960	00237	1	99763	1
60	12 0	48 0	01923	132	98077	02162	133	97838	00239	1	99761	0
M.	Hour P. M.	Hour A. M.	Cosine.	Diff.	Secant.	Cotangent.	Diff.	Tangent.	Cosecant.	Diff.	Sine.	M.

95° 84°

M.	Hour A. M.	Hour P. M.	Sine.	Diff.	Cosecant.	Tangent.	Diff.	Cotangent.	Secant.	Diff.	Cosine.	M.
0	11 12 0	0 48 0	9. 01923	0	10. 98077	9. 02162	0	10. 97838	10. 00239	0	9. 99761	60
1	11 52	48 8	02043	2	97957	02283	2	97717	00240	0	99760	59
2	11 44	48 16	02163	4	97837	02404	4	97596	00241	0	99759	58
3	11 36	48 24	02283	6	97717	02525	6	97475	00243	0	99757	57
4	11 28	48 32	02402	7	97598	02645	8	97355	00244	0	99756	56
5	11 11 20	0 48 40	9. 02520	0	10. 97480	9. 02766	9	10. 97234	10. 00245	0	9. 99755	55
6	11 12	48 48	02639	11	97361	02885	11	97115	00247	0	99753	54
7	11 4	48 56	02757	13	97243	03005	13	96995	00248	0	99752	53
8	10 56	49 4	02874	15	97126	03124	15	96876	00249	0	99751	52
9	10 48	49 12	02992	17	97008	03242	17	96758	00251	0	99749	51
10	11 10 40	0 49 20	9. 03109	19	10. 96891	9. 03361	19	10. 96639	10. 00252	0	9. 99748	50
11	10 32	49 28	03226	20	96774	03479	21	96521	00253	0	99747	49
12	10 24	49 36	03342	22	96658	03597	23	96403	00255	0	99745	48
13	10 16	49 44	03458	24	96542	03714	24	96286	00256	0	99744	47
14	10 8	49 52	03574	26	96426	03832	26	96168	00258	0	99742	46
15	11 10 0	0 50 0	9. 03690	28	10. 96310	9. 03948	28	10. 96052	10. 00259	0	9. 99741	45
16	9 52	50 8	03805	30	96195	04065	30	95935	00260	0	99740	44
17	9 44	50 16	03920	31	96080	04181	32	95819	00262	0	99738	43
18	9 36	50 24	04034	33	95966	04297	34	95703	00263	0	99737	42
19	9 28	50 32	04149	35	95851	04413	36	95587	00264	0	99736	41
20	11 9 20	0 50 40	9. 04262	37	10. 95738	9. 04528	38	10. 95472	10. 00266	0	9. 99734	40
21	9 12	50 48	04376	39	95624	04643	39	95357	00267	1	99733	39
22	9 4	50 56	04490	41	95510	04758	41	95242	00269	1	99731	38
23	8 56	51 4	04603	43	95397	04873	43	95127	00270	1	99730	37
24	8 48	51 12	04715	44	95285	04987	45	95013	00272	1	99728	36
25	11 8 40	0 51 20	9. 04828	46	10. 95172	9. 05101	47	10. 94899	10. 00273	1	9. 99727	35
26	8 32	51 28	04940	48	95060	05214	49	94786	00274	1	99726	34
27	8 24	51 36	05052	50	94948	05328	51	94672	00276	1	99724	33
28	8 16	51 44	05164	52	94836	05441	53	94559	00277	1	99723	32
29	8 8	51 52	05275	54	94725	05553	54	94447	00279	1	99721	31
30	11 8 0	0 52 0	9. 05386	56	10. 94614	9. 05666	56	10. 94334	10. 00280	1	9. 99720	30
31	7 52	52 8	05497	57	94503	05778	58	94222	00282	1	99718	29
32	7 44	52 16	05607	59	94393	05890	60	94110	00283	1	99717	28
33	7 36	52 24	05717	61	94283	06002	62	93998	00284	1	99716	27
34	7 28	52 32	05827	63	94173	06113	64	93887	00286	1	99714	26
35	11 7 20	0 52 40	9. 05937	65	10. 94063	9. 06224	66	10. 93776	10. 00287	1	9. 99713	25
36	7 12	52 48	06046	67	93954	06335	68	93665	00289	1	99711	24
37	7 4	52 56	06155	69	93845	06445	69	93555	00290	1	99710	23
38	6 56	53 4	06264	70	93736	06556	71	93444	00292	1	99708	22
39	6 48	53 12	06372	72	93628	06666	73	93334	00293	1	99707	21
40	11 6 40	0 53 20	9. 06481	74	10. 93519	9. 06775	75	10. 93225	10. 00295	1	9. 99705	20
41	6 32	53 28	06589	76	93411	06885	77	93115	00296	1	99704	19
42	6 24	53 36	06696	78	93304	06994	79	93006	00298	1	99702	18
43	6 16	53 44	06804	80	93196	07103	81	92897	00299	1	99701	17
44	6 8	53 52	06911	81	93089	07211	83	92789	00301	1	99699	16
45	11 6 0	0 54 0	9. 07018	83	10. 92982	9. 07320	84	10. 92680	10. 00302	1	9. 99698	15
46	5 52	54 8	07124	85	92876	07428	86	92572	00304	1	99696	14
47	5 44	54 16	07231	87	92769	07536	88	92464	00305	1	99695	13
48	5 36	54 24	07337	89	92663	07643	90	92357	00307	1	99693	12
49	5 28	54 32	07442	91	92558	07751	92	92249	00308	1	99692	11
50	11 5 20	0 54 40	9. 07548	93	10. 92452	9. 07858	94	10. 92142	10. 00310	1	9. 99690	10
51	5 12	54 48	07653	94	92347	07964	96	92036	00311	1	99689	9
52	5 4	54 56	07758	96	92242	08071	98	91929	00313	1	99687	8
53	4 56	55 4	07863	98	92137	08177	99	91823	00314	1	99686	7
54	4 48	55 12	07968	100	92032	08283	101	91717	00316	1	99684	6
55	11 4 40	0 55 20	9. 08073	102	10. 91928	9. 08389	103	10. 91611	10. 00317	1	9. 99683	5
56	4 32	55 28	08176	104	91824	08495	105	91505	00319	1	99681	4
57	4 24	55 36	08280	106	91720	08600	107	91400	00320	1	99680	3
58	4 16	55 44	08383	107	91617	08705	109	91295	00322	1	99678	2
59	4 8	55 52	08486	109	91514	08810	111	91190	00323	1	99677	1
60	4 0	56 0	08589	111	91411	08914	113	91086	00325	1	99675	0
M.	Hour P. M.	Hour A. M.	Cosine.	Diff.	Secant.	Cotangent.	Diff.	Tangent.	Cosecant.	Diff.	Sine.	M.
96°												84°

SINES, TANGENTS, AND SECANTS.

7° 172°

M.	Hour A. M.	Hour P. M.	Sine.	Diff.	Cosecant.	Tangent.	Diff.	Cotangent.	Secant.	Diff.	Cosine.	M.
0	11 4 0	0 56 0	9. 08589	0	10. 91411	9. 08914	0	10. 91086	10. 00325	0	9. 99675	60
1	3 52	56 8	08692	2	91308	09019	2	90981	.00326	0	99674	59
2	3 44	56 16	08795	3	91205	09123	3	90877	00328	0	99672	58
3	3 36	56 24	08897	5	91103	09227	5	90773	00330	0	99670	57
4	3 28	56 32	08999	6	91001	09330	7	90670	00331	0	99669	56
5	11 3 20	0 56 40	9. 09101	8	10. 90899	9. 09434	8	10. 90566	10. 00333	0	9. 99667	55
6	3 12	56 48	09202	10	90798	09537	10	90463	00334	0	99666	54
7	3 4	56 56	09304	11	90696	09640	11	90360	00336	0	99664	53
8	2 56	57 4	09405	13	90595	09742	13	90258	00337	0	99663	52
9	2 48	57 12	09506	14	90494	09845	15	90155	00339	0	99661	51
10	11 2 40	0 57 20	9. 09606	16	10. 90394	9. 09947	16	10. 90053	10. 00341	0	9. 99659	50
11	2 32	57 28	09707	18	90293	10049	18	89951	00342	0	99658	49
12	2 24	57 36	09807	19	90193	10150	20	89850	00344	0	99656	48
13	2 16	57 44	09907	21	90093	10252	21	89748	00345	0	99655	47
14	2 8	57 52	10006	22	89994	10353	23	89647	00347	0	99653	46
15	11 2 0	0 58 0	9. 10106	24	10. 89894	9. 10454	24	10. 89546	10. 00349	0	9. 99651	45
16	1 52	58 8	10205	26	89795	10555	26	89445	00350	0	99650	44
17	1 44	58 16	10304	27	89696	10656	28	89344	00352	0	99648	43
18	1 36	58 24	10402	29	89598	10756	29	89244	00353	1	99647	42
19	1 28	58 32	10501	30	89499	10856	31	89144	00355	1	99645	41
20	11 1 20	0 58 40	9. 10599	32	10. 89401	9. 10956	33	10. 89044	10. 00357	1	9. 99643	40
21	1 12	58 48	10697	34	89303	11056	34	88944	00358	1	99642	39
22	1 4	58 56	10795	35	89205	11155	36	88845	00360	1	99640	38
23	0 56	59 4	10893	37	89107	11254	37	88746	00362	1	99638	37
24	0 48	59 12	10990	38	89010	11353	39	88647	00363	1	99637	36
25	11 0 40	0 59 20	9. 11087	40	10. 88913	9. 11452	41	10. 88548	10. 00365	1	9. 99635	35
26	0 32	59 28	11184	42	88816	11551	42	88449	00367	1	99633	34
27	0 24	59 36	11281	43	88719	11649	44	88351	00368	1	99632	33
28	0 16	59 44	11377	45	88623	11747	46	88253	00370	1	99630	32
29	0 8	59 52	11474	47	88526	11845	47	88155	00371	1	99629	31
30	11 0 0	1 0 0	9. 11570	48	10. 88430	9. 11943	49	10. 88057	10. 00373	1	9. 99627	30
31	10 59 52	0 8	11666	50	88334	12040	51	87960	00375	1	99625	29
32	59 44	0 16	11761	51	88239	12138	52	87862	00376	1	99624	28
33	59 36	0 24	11857	53	88143	12235	54	87765	00378	1	99622	27
34	59 28	0 32	11952	54	88048	12332	55	87668	00380	1	99620	26
35	10 59 20	1 0 40	9. 12047	56	10. 87953	9. 12428	57	10. 87572	10. 00382	1	9. 99618	25
36	59 12	0 48	12142	58	87858	12525	59	87475	00383	1	99617	24
37	59 4	0 56	12236	59	87764	12621	60	87379	00385	1	99615	23
38	58 56	1 4	12331	61	87669	12717	62	87283	00387	1	99613	22
39	58 48	1 12	12425	62	87575	12813	64	87187	00388	1	99612	21
40	10 58 40	1 1 20	9. 12519	64	10. 87481	9. 12909	65	10. 87091	10. 00390	1	9. 99610	20
41	58 32	1 28	12612	66	87388	13004	67	86996	00392	1	99608	19
42	58 24	1 36	12706	67	87294	13099	68	86901	00393	1	99607	18
43	58 16	1 44	12799	69	87201	13194	70	86806	00395	1	99605	17
44	58 8	1 52	12892	70	87108	13289	72	86711	00397	1	99603	16
45	10 58 0	1 2 0	9. 12985	72	10. 87015	9. 13384	73	10. 86616	10. 00399	1	9. 99601	15
46	57 52	2 8	13078	74	86922	13478	75	86522	00400	1	99600	14
47	57 44	2 16	13171	75	86829	13573	77	86427	00402	1	99598	13
48	57 36	2 24	13263	77	86737	13667	78	86333	00404	1	99596	12
49	57 28	2 32	13355	78	86645	13761	80	86239	00405	1	99595	11
50	10 57 20	1 2 40	9. 13447	80	10. 86553	9. 13854	81	10. 86146	10. 00407	1	9. 99593	10
51	57 12	2 48	13539	82	86461	13948	83	86052	00409	1	99591	9
52	57 4	2 56	13630	83	86370	14041	85	85959	00411	1	99589	8
53	56 56	3 4	13722	85	86278	14134	86	85866	00412	1	99588	7
54	56 48	3 12	13813	87	86187	14227	88	85773	00414	2	99586	6
55	10 56 40	1 3 20	9. 13904	88	10. 86096	9. 14320	90	10. 85680	10. 00416	2	9. 99584	5
56	56 32	3 28	13994	90	86006	14412	91	85588	00418	2	99582	4
57	56 24	3 36	14085	91	85915	14504	93	85496	00419	2	99581	3
58	56 16	3 44	14175	93	85825	14597	95	85403	00421	2	99579	2
59	56 8	3 52	14266	95	85734	14688	96	85312	00423	2	99577	1
60	56 0	4 0	14356	96	85644	14780	98	85220	00425	2	99575	0
M.	Hour P. M.	Hour A. M.	Cosine.	Diff.	Secant.	Cotangent.	Diff.	Tangent.	Cosecant.	Diff.	Sine.	M.

97° 82°

SINES, TANGENTS, AND SECANTS.

8° 171°

M.	Hour A. M.	Hour P. M.	Sine.	Diff.	Cosecant.	Tangent.	Diff.	Cotangent.	Secant.	Diff.	Cosine.	M.
0	10 56 0	1 4 0	9. 14356	0	10. 85644	9. 14780	0	10. 85220	10. 00425	0	9. 99575	60
1	55 52	4 8	14445	1	85555	14872	1	85128	00426	0	99574	59
2	55 44	4 16	14535	3	85465	14963	3	85037	00428	0	99572	58
3	55 36	4 24	14624	4	85376	15054	4	84946	00430	0	99570	57
4	55 28	4 32	14714	6	85286	15147	6	84855	00432	0	99568	56
5	10 55 20	1 4 40	9. 14803	7	10. 85197	9. 15236	7	10. 84764	10. 00434	0	9. 99566	55
6	55 12	4 48	14891	8	85109	15327	9	84673	00435	0	99565	54
7	55 4	4 56	14980	10	85020	15417	10	84583	00437	0	99563	53
8	54 56	5 4	15069	11	84931	15508	12	84492	00439	0	99561	52
9	54 48	5 12	15157	13	84843	15598	13	84402	00441	0	99559	51
10	10 54 40	1 5 20	9. 15245	14	10. 84755	9. 15688	14	10. 84312	10. 00443	0	9. 99557	50
11	54 32	5 28	15333	16	84667	15777	16	84223	00444	0	99556	49
12	54 24	5 36	15421	17	84579	15867	17	84133	00446	0	99554	48
13	54 16	5 44	15508	18	84492	15956	19	84044	00448	0	99552	47
14	54 8	5 52	15596	20	84404	16046	20	83954	00450	0	99550	46
15	10 54 0	1 6 0	9. 15683	21	10. 84317	9. 16135	22	10. 83865	10. 00452	0	9. 99548	45
16	53 52	6 8	15770	23	84230	16224	23	83776	00454	1	99546	44
17	53 44	6 16	15857	24	84143	16312	25	83688	00455	1	99545	43
18	53 36	6 24	15944	25	84056	16401	26	83599	00457	1	99543	42
19	53 28	6 32	16030	27	83970	16489	27	83511	00459	1	99541	41
20	10 53 20	1 6 40	9. 16116	28	10. 83884	9. 16577	29	10. 83423	10. 00461	1	9. 99539	40
21	53 12	6 48	16203	30	83797	16665	30	83335	00463	1	99537	39
22	53 4	6 56	16289	31	83711	16753	32	83247	00465	1	99535	38
23	52 56	7 4	16374	32	83626	16841	33	83159	00467	1	99533	37
24	52 48	7 12	16460	34	83540	16928	35	83072	00468	1	99532	36
25	10 52 40	1 7 20	9. 16545	35	10. 83455	9. 17016	36	10. 82984	10. 00470	1	9. 99530	35
26	52 32	7 28	16631	37	83369	17103	37	82897	00472	1	99528	34
27	52 24	7 36	16716	38	83284	17190	39	82810	00474	1	99526	33
28	52 16	7 44	16801	39	83199	17277	40	82723	00476	1	99524	32
29	52 8	7 52	16886	41	83114	17363	42	82637	00478	1	99522	31
30	10 52 0	1 8 0	9. 16970	42	10. 83030	9. 17450	43	10. 82550	10. 00480	1	9. 99520	30
31	51 52	8 8	17055	44	82945	17536	45	82464	00482	1	99518	29
32	51 44	8 16	17139	45	82861	17622	46	82378	00483	1	99517	28
33	51 36	8 24	17223	47	82777	17708	48	82292	00485	1	99515	27
34	51 28	8 32	17307	48	82693	17794	49	82206	00487	1	99513	26
35	10 51 20	1 8 40	9. 17391	49	10. 82609	9. 17880	50	10. 82120	10. 00489	1	9. 99511	25
36	51 12	8 48	17474	51	82526	17965	52	82035	00491	1	99509	24
37	51 4	8 56	17558	52	82442	18051	53	81949	00493	1	99507	23
38	50 56	9 4	17641	54	82359	18136	55	81864	00495	1	99505	22
39	50 48	9 12	17724	55	82276	18221	56	81779	00497	1	99503	21
40	10 50 40	1 9 20	9. 17807	56	10. 82193	9. 18306	58	10. 81694	10. 00499	1	9. 99501	20
41	50 32	9 28	17890	58	82110	18391	59	81609	00501	1	99499	19
42	50 24	9 36	17973	59	82027	18475	61	81525	00503	1	99497	18
43	50 16	9 44	18055	61	81945	18560	62	81440	00505	1	99495	17
44	50 8	9 52	18137	62	81863	18644	63	81356	00506	1	99494	16
45	10 50 0	1 10 0	9. 18220	63	10. 81780	9. 18728	65	10. 81272	10. 00508	1	9. 99492	15
46	49 52	10 8	18302	65	81698	18812	66	81188	00510	1	99490	14
47	49 44	10 16	18383	66	81617	18896	68	81104	00512	1	99488	13
48	49 36	10 24	18465	68	81535	18979	69	81021	00514	2	99486	12
49	49 28	10 32	18547	69	81453	19063	71	80937	00516	2	99484	11
50	10 49 20	1 10 40	9. 18628	71	10. 81372	9. 19146	72	10. 80854	10. 00518	2	9. 99482	10
51	49 12	10 48	18709	72	81291	19229	74	80771	00520	2	99480	9
52	49 4	10 56	18790	73	81210	19312	75	80688	00522	2	99478	8
53	48 56	11 4	18871	75	81129	19395	76	80605	00524	2	99476	7
54	48 48	11 12	18952	76	81048	19478	78	80522	00526	2	99474	6
55	10 48 40	1 11 20	9. 19033	78	10. 80967	9. 19561	79	10. 80439	10. 00528	2	9. 99472	5
56	48 32	11 28	19113	79	80887	19643	81	80357	00530	2	99470	4
57	48 24	11 36	19193	80	80807	19725	82	80275	00532	2	99468	3
58	48 16	11 44	19273	82	80727	19807	84	80193	00534	2	99466	2
59	48 8	11 52	19353	83	80647	19889	85	80111	00536	2	99464	1
60	48 0	12 0	19433	85	80567	19971	87	80029	00538	2	99462	0
M.	Hour P. M.	Hour A. M.	Cosine.	Diff.	Secant	Cotangent.	Diff.	Tangent	Cosecant.	Diff.	Sine	M

98° 81°

SINES, TANGENTS, AND SECANTS.

9°												170°
M.	Hour A. M.	Hour P. M.	Sine.	Diff.	Cosecant.	Tangent.	Diff.	Cotangent.	Secant.	Diff.	Cosine.	M.
0	10. 48 0	1 12 0	9. 19433	0	10. 80567	9. 19971	0	10. 80029	10. 00538	0	9. 99462	60
1	47 52	12 8	19513	1	80487	20053	1	79947	00540	0	99460	59
2	47 44	12 16	19592	3	80408	20134	3	79865	00542	0	99458	58
3	47 36	12 24	19672	4	80328	20216	4	79784	00544	0	99456	57
4	47 28	12 32	19751	5	80249	20297	5	79703	00546	0	99454	56
5	10 47 20	1 12 40	9. 19830	6	10. 80170	9. 20378	6	10. 79622	10. 00548	0	9. 99452	55
6	47 12	12 48	19909	8	80091	20459	8	79541	00550	0	99450	54
7	47 4	12 56	19988	9	80012	20540	9	79460	00552	0	99448	53
8	46 56	13 4	20067	10	79933	20621	10	79379	00554	0	99446	52
9	46 48	13 12	20145	11	79855	20701	12	79299	00556	0	99444	51
10	10 46 40	1 13 20	9. 20223	13	10. 79777	9. 20782	13	10. 79218	10. 00558	0	9. 99442	50
11	46 32	13 28	20302	14	79698	20862	14	79138	00560	0	99440	49
12	46 24	13 36	20380	15	79620	20942	16	79058	00562	0	99438	48
13	46 16	13 44	20458	16	79542	21022	17	78978	00564	0	99436	47
14	46 8	13 52	20535	18	79465	21102	18	78898	00566	0	99434	46
15	10 45 0	1 14 0	9. 20613	19	10. 79387	9. 21182	19	10. 78818	10. 00568	1	9. 99432	45
16	45 52	14 8	20691	20	79309	21261	21	78739	00571	1	99429	44
17	45 44	14 16	20768	21	79232	21341	22	78659	00573	1	99427	43
18	45 36	14 24	20845	23	79155	21420	23	78580	00575	1	99425	42
19	45 28	14 32	20922	24	79078	21499	25	78501	00577	1	99423	41
20	10 45 20	1 14 40	9. 20999	25	10. 79001	9. 21578	26	10. 78422	10. 00579	1	9. 99421	40
21	45 12	14 48	21076	26	78924	21657	27	78343	00581	1	99419	39
22	45 4	14 56	21153	28	78847	21736	28	78264	00583	1	99417	38
23	44 56	15 4	21229	29	78771	21814	30	78186	00585	1	99415	37
24	44 48	15 12	21306	30	78694	21893	31	78107	00587	1	99413	36
25	10 44 40	1 15 20	9. 21382	31	10. 78618	9. 21971	32	10. 78029	10. 00589	1	9. 99411	35
26	44 32	15 28	21458	33	78542	22049	34	77951	00591	1	99409	34
27	44 24	15 36	21534	34	78466	22127	35	77873	00593	1	99407	33
28	44 16	15 44	21610	35	78390	22205	36	77795	00596	1	99404	32
29	44 8	15 52	21685	37	78315	22283	38	77717	00598	1	99402	31
30	10 44 0	1 16 0	9. 21761	38	10. 78239	9. 22361	39	10. 77639	10. 00600	1	9. 99400	30
31	43 52	16 8	21836	39	78164	22438	40	77562	00602	1	99398	29
32	43 44	16 16	21912	40	78088	22516	41	77484	00604	1	99396	28
33	43 36	16 24	21987	42	78013	22593	43	77407	00606	1	99394	27
34	43 28	16 32	22062	43	77938	22670	44	77330	00608	1	99392	26
35	10 43 20	1 16 40	9. 22137	44	10. 77863	9. 22747	45	10. 77253	10. 00610	1	9. 99390	25
36	43 12	16 48	22211	45	77789	22824	47	77176	00612	1	99388	24
37	43 4	16 56	22286	47	77714	22901	48	77099	00615	1	99385	23
38	42 56	17 4	22361	48	77639	22977	49	77023	00617	1	99383	22
39	42 48	17 12	22435	49	77565	23054	50	76946	00619	1	99381	21
40	10 42 40	1 17 20	9. 22509	50	10. 77491	9. 23130	52	10. 76870	10. 00621	1	9. 99379	20
41	42 32	17 28	22583	52	77417	23206	53	76794	00623	1	99377	19
42	42 24	17 36	22657	53	77343	23283	54	76717	00625	1	99375	18
43	42 16	17 44	22731	54	77269	23359	56	76641	00628	1	99372	17
44	42 8	17 52	22805	55	77195	23435	57	76565	00630	1	99370	16
45	10 42 0	1 18 0	9. 22878	57	10. 77122	9. 23510	58	10. 76490	10. 00632	2	9. 99368	15
46	41 52	18 8	22952	58	77048	23586	60	76414	00634	2	99366	14
47	41 44	18 16	23025	59	76975	23661	61	76339	00636	2	99364	13
48	41 36	18 24	23098	62	76902	23737	62	76263	00638	2	99362	12
49	41 28	18 32	23171	62	76829	23812	63	76188	00641	2	99359	11
50	10 41 20	1 18 40	9. 23244	63	10. 76756	9. 23887	65	10. 76113	10. 00643	2	99357	10
51	41 12	18 48	23317	64	76683	23962	66	76038	00645	2	99355	9
52	41 4	18 56	23390	65	76610	24037	67	75963	00647	2	99353	8
53	40 56	19 4	23462	67	76538	24112	69	75888	00649	2	99351	7
54	40 48	19 12	23535	68	76465	24186	70	75814	00652	2	99348	6
55	10 40 40	1 19 20	9. 23607	69	10. 76393	9. 24261	71	10. 75739	10. 00654	2	9. 99346	5
56	40 32	19 28	23679	71	76321	24335	73	75665	00656	2	99344	4
57	40 24	19 36	23752	72	76248	24410	74	75590	00658	2	99342	3
58	40 16	19 44	23823	73	76177	24484	75	75516	00660	2	99340	2
59	40 8	19 52	23895	74	76105	24558	76	75442	00663	2	99337	1
60	40 0	20 0	23967	76	76033	24632	78	75368	00665	2	99335	0
M.	Hour P. M.	Hour A. M.	Cosine.	Diff.	Secant.	Cotangent.	Diff.	Tangent	Cosecant.	Diff.	Sine.	M.
99°												80°

SINES, TANGENTS, AND SECANTS.

10°												100°
M.	Hour A. M.	Hour P. M.	Sine.	Diff.	Cosecant.	Tangent.	Diff.	Cotangent.	Secant.	Diff.	Cosine.	M.
0	10 40 0	1 20 0	9. 23967	0	10. 76033	9. 24632	0	10. 75368	10. 00665	0	9. 99335	60
1	39 52	20 8	24039	1	75961	24706	1	75294	00667	0	99333	59
2	39 44	20 16	24110	2	75890	24779	2	75221	00669	0	99331	58
3	39 36	20 24	24181	3	75819	24853	4	75147	00672	0	99328	57
4	39 28	20 32	24253	5	75747	24926	5	75074	00674	0	99326	56
5	10 39 20	1 20 40	9. 24324	6	10. 75676	9. 25000	6	10. 75000	10. 00676	0	9. 99324	55
6	39 12	20 48	24395	7	75605	25073	7	74927	00678	0	99322	54
7	39 4	20 56	24466	8	75534	25146	8	74854	00681	0	99319	53
8	38 56	21 4	24536	9	75464	25219	9	74781	00683	0	99317	52
9	38 48	21 12	24607	10	75393	25292	11	74708	00685	0	99315	51
10	10 38 40	1 21 20	9. 24677	11	10. 75323	9. 25365	12	10. 74635	10. 00687	0	9. 99313	50
11	38 32	21 28	24748	13	75252	25437	13	74563	00690	0	99310	49
12	38 24	21 36	24818	14	75182	25510	14	74490	00692	0	99308	48
13	38 16	21 44	24888	15	75112	25582	15	74418	00694	1	99306	47
14	38 8	21 52	24958	16	75042	25655	16	74345	00696	1	99304	46
15	10 38 0	1 22 0	9. 25028	17	10. 74972	9. 25727	18	10. 74273	10. 00699	1	9. 99301	45
16	37 52	22 8	25098	18	74902	25799	19	74201	00701	1	99299	44
17	37 44	22 16	25168	19	74832	25871	20	74129	00703	1	99297	43
18	37 36	22 24	25237	20	74763	25943	21	74057	00706	1	99294	42
19	37 28	22 32	25307	22	74693	26015	22	73985	00708	1	99292	41
20	10 37 20	1 22 40	9. 25376	23	10. 74624	9. 26086	24	10. 73914	10. 00710	1	9. 99290	40
21	37 12	22 48	25445	24	74555	26158	25	73842	00712	1	99288	39
22	37 4	22 56	25514	25	74486	26229	26	73771	00715	1	99285	38
23	36 56	23 4	25583	26	74417	26301	27	73699	00717	1	99283	37
24	36 48	23 12	25652	27	74348	26372	28	73628	00719	1	99281	36
25	10 36 40	1 23 20	9. 25721	28	10. 74279	9. 26443	29	10. 73557	10. 00722	1	9. 99278	35
26	36 32	23 28	25790	30	74210	26514	31	73486	00724	1	99276	34
27	36 24	23 36	25858	31	74142	26585	32	73415	00726	1	99274	33
28	36 16	23 44	25927	32	74073	26655	33	73345	00729	1	99271	32
29	36 8	23 52	25995	33	74005	26726	34	73274	00731	1	99269	31
30	10 36 0	1 24 0	9. 26063	34	10. 73937	9. 26797	35	10. 73203	10. 00733	1	9. 99267	30
31	35 52	24 8	26131	35	73869	26867	36	73133	00736	1	99264	29
32	35 44	24 16	26199	36	73801	26937	38	73063	00738	1	99262	28
33	35 36	24 24	26267	38	73733	27008	39	72992	00740	1	99260	27
34	35 28	24 32	26335	39	73665	27078	40	72922	00743	1	99257	26
35	10 35 20	1 24 40	9. 26403	40	10. 73597	9. 27148	41	10. 72852	10. 00745	1	9. 99255	25
36	35 12	24 48	26470	41	73530	27218	42	72782	00748	1	99252	24
37	35 4	24 56	26538	42	73462	27288	44	72712	00750	1	99250	23
38	34 56	25 4	26605	43	73395	27357	45	72643	00752	1	99248	22
39	34 48	25 12	26672	44	73328	27427	46	72573	00755	2	99245	21
40	10 34 40	1 25 20	9. 26739	45	10. 73261	9. 27496	47	10. 72504	10. 00757	2	9. 99243	20
41	34 32	25 28	26806	47	73194	27566	48	72434	00759	2	99241	19
42	34 24	25 36	26873	48	73127	27635	49	72365	00762	2	99238	18
43	34 16	25 44	26940	49	73060	27704	51	72296	00764	2	99236	17
44	34 8	25 52	27007	50	72993	27773	52	72227	00767	2	99233	16
45	10 34 0	1 26 0	9. 27073	51	10. 72927	9. 27842	53	10. 72158	10. 00769	2	9. 99231	15
46	33 52	26 8	27140	52	72860	27911	54	72089	00771	2	99229	14
47	33 44	26 16	27206	53	72794	27980	55	72020	00774	2	99226	13
48	33 36	26 24	27273	55	72727	28049	56	71951	00776	2	99224	12
49	33 28	26 32	27339	56	72661	28117	58	71883	00779	2	99221	11
50	10 33 20	1 26 40	9. 27405	57	10. 72595	9. 28186	59	10. 71814	10. 00781	2	9. 99219	10
51	33 12	26 48	27471	58	72529	28254	60	71746	00783	2	99217	9
52	33 4	26 56	27537	59	72463	28323	61	71677	00786	2	99214	8
53	32 56	27 4	27602	60	72398	28391	62	71609	00788	2	99212	7
54	32 48	27 12	27668	61	72332	28459	63	71541	00791	2	99209	6
55	10 32 40	1 27 20	9. 27734	63	10. 72266	9. 28527	65	10. 71473	10. 00793	2	9. 99207	5
56	32 32	27 28	27799	64	72201	28595	66	71405	00796	2	99204	4
57	32 24	27 36	27864	65	72136	28662	67	71338	00798	2	99202	3
58	32 16	27 44	27930	66	72070	28730	68	71270	00800	2	99200	2
59	32 8	27 52	27995	67	72005	28798	69	71202	00803	2	99197	1
60	32 0	28 0	28060	68	71940	28865	71	71135	00805	2	99195	0
M.	Hour P. M.	Hour A. M.	Cosine.	Diff.	Secant.	Cotangent.	Diff.	Tangent.	Cosecant.	Diff.	Sine.	M.
100°												79°

SINES, TANGENTS, AND SECANTS.

11°											168°
M.	Hour A. M.	Hour P. M.	Sine.	Diff.	Cosecant.	Tangent.	Diff.	Cotangent.	Secant.	Diff.	Cosine.	M.
0	10 32 0	1 28 0	9. 28060	0	10. 71940	9. 28865	0	10. 71135	10. 00805	0	9. 99195	60
1	31 52	28 8	28125	1	71875	28933	1	71067	00808	0	99192	59
2	31 44	28 16	28190	2	71810	29000	2	71000	00810	0	99190	58
3	31 36	28 24	28254	3	71746	29067	3	70933	00813	0	99187	57
4	31 28	28 32	28319	4	71681	29134	4	70866	00815	0	99185	56
5	10 31 20	1 28 40	9. 28384	5	10. 71616	9. 29201	5	10. 70799	10. 00818	0	9. 99182	55
6	31 12	28 48	28448	6	71552	29268	6	70732	00820	0	99180	54
7	31 4	28 56	28512	7	71488	29335	8	70665	00823	0	99177	53
8	30 56	29 4	28577	8	71423	29402	9	70598	00825	0	99175	52
9	30 48	29 12	28641	9	71359	29468	10	70532	00828	0	99172	51
10	30 40	1 29 20	9. 28705	10	10. 71295	9. 29535	11	10. 70465	10. 00830	0	9. 99170	50
11	30 32	29 28	28769	11	71231	29601	12	70399	00833	0	99167	49
12	30 24	29 36	28833	12	71167	29668	13	70332	00835	1	99165	48
13	30 16	29 44	28896	13	71104	29734	14	70266	00838	1	99162	47
14	30 8	29 52	28960	14	71040	29800	15	70200	00840	1	99160	46
15	10 30 0	1 30 0	9. 29024	16	10. 70976	9. 29866	16	10. 70134	10. 00843	1	9. 99157	45
16	29 52	30 8	29087	17	70913	29932	17	70068	00845	1	99155	44
17	29 44	30 16	29150	18	70850	29998	18	70002	00848	1	99152	43
18	29 36	30 24	29214	19	70786	30064	19	69936	00850	1	99150	42
19	29 28	30 32	29277	20	70723	30130	20	69870	00853	1	99147	41
20	10 29 20	1 30 40	9. 29340	21	10. 70660	9. 30195	22	10. 69805	10. 00855	1	9. 99145	40
21	29 12	30 48	29403	22	70597	30261	23	69739	00858	1	99142	39
22	29 4	30 56	29466	23	70534	30326	24	69674	00860	1	99140	38
23	28 56	31 4	29529	24	70471	30391	25	69609	00863	1	99137	37
24	28 48	31 12	29591	25	70409	30457	26	69543	00865	1	99135	36
25	10 28 40	1 31 20	9. 29654	26	10. 70346	9. 30522	27	10. 69478	10. 00868	1	9. 99132	35
26	28 32	31 28	29716	27	70284	30587	28	69413	00870	1	99130	34
27	28 24	31 36	29779	28	70221	30652	29	69348	00873	1	99127	33
28	28 16	31 44	29841	29	70159	30717	30	69283	00876	1	99124	32
29	28 8	31 52	29903	30	70097	30782	31	69218	00878	1	99122	31
30	10 28 0	1 32 0	9. 29966	31	10. 70034	9. 30846	32	10. 69154	10. 00881	1	9. 99119	30
31	27 52	32 8	30028	32	69972	30911	33	69089	00883	1	99117	29
32	27 44	32 16	30090	33	69910	30975	35	69025	00886	1	99114	28
33	27 36	32 24	30151	34	69849	31040	36	68960	00888	1	99112	27
34	27 28	32 32	30213	35	69787	31104	37	68896	00891	1	99109	26
35	10 27 20	1 32 40	9. 30275	36	10. 69725	9. 31168	38	10. 68832	10. 00894	2	9. 99106	25
36	27 12	32 48	30336	37	69664	31233	39	68767	00896	2	99104	24
37	27 4	32 56	30398	38	69602	31297	40	68703	00899	2	99101	23
38	26 56	33 4	30459	39	69541	31361	41	68639	00901	2	99099	22
39	26 48	33 12	30521	40	69479	31425	42	68575	00904	2	99096	21
40	10 26 40	1 33 20	9. 30582	41	10. 69418	9. 31489	43	10. 68511	10. 00907	2	9. 99093	20
41	26 32	33 28	30643	42	69357	31552	44	68448	00909	2	99091	19
42	26 24	33 36	30704	43	69296	31616	45	68384	00912	2	99088	18
43	26 16	33 44	30765	45	69235	31679	46	68321	00914	2	99086	17
44	26 8	33 52	30826	46	69174	31743	47	68257	00917	2	99083	16
45	10 26 0	1 34 0	9. 30887	47	10. 69113	9. 31806	49	10. 68194	10. 00920	2	9. 99080	15
46	25 52	34 8	30947	48	69053	31870	50	68130	00922	2	99078	14
47	25 44	34 16	31008	49	68992	31933	51	68067	00925	2	99075	13
48	25 36	34 24	31068	50	68932	31996	52	68004	00928	2	99072	12
49	25 28	34 32	31129	51	68871	32059	53	67941	00930	2	99070	11
50	10 25 20	1 34 40	9. 31189	52	10. 68811	9. 32122	54	10. 67878	10. 00933	2	9. 99067	10
51	25 12	34 48	31250	53	68750	32185	55	67815	00936	2	99064	9
52	25 4	34 56	31310	54	68690	32248	56	67752	00938	2	99062	8
53	24 56	35 4	31370	55	68630	32311	57	67689	00941	2	99059	7
54	24 48	35 12	31430	56	68570	32373	58	67627	00944	2	99056	6
55	10 24 40	1 35 20	9. 31490	57	10. 68510	9. 32436	59	10. 67564	10. 00946	2	9. 99054	5
56	24 32	35 28	31549	58	68451	32498	60	67502	00949	2	99051	4
57	24 24	35 36	31609	59	68391	32561	61	67439	00952	2	99048	3
58	24 16	35 44	31669	60	68331	32623	63	67377	00954	2	99046	2
59	24 8	35 52	31728	61	68272	32685	64	67315	00957	3	99043	1
60	24 0	36 0	31788	62	68212	32747	65	67253	00960	3	99040	0
M.	Hour P. M.	Hour A. M.	Cosine.	Diff.	Secant.	Cotangent.	Diff.	Tangent.	Cosecant.	Diff.	Sine.	M.
101°												78°

SINES, TANGENTS, AND SECANTS

12°											167°
M.	Hour A. M.	Hour P. M.	Sine.	Diff.	Cosecant.	Tangent.	Diff.	Cotangent.	Secant.	Diff.	Cosine.	M.
0	10 24 0	1 36 0	9. 31788	0	10. 68212	9. 32747	0	10. 67253	10. 00960	0	9. 99040	60
1	23 52	36 8	31847	1	68153	32810	1	67190	00962	0	99038	59
2	23 44	36 16	31907	2	68093	32872	2	67128	00965	0	99035	58
3	23 36	36 24	31966	3	68034	32933	3	67067	00968	0	99032	57
4	23 28	36 32	32025	4	67975	32995	4	67005	00970	0	99030	56
5	10 23 20	1 36 40	9. 32084	5	10. 67916	9. 33057	5	10. 66943	10. 00973	0	9. 99027	55
6	23 12	36 48	32143	6	67857	33119	6	66881	00976	0	99024	54
7	23 4	36 56	32202	7	67798	33180	7	66820	00978	0	99022	53
8	22 56	37 4	32261	8	67739	33242	8	66758	00981	0	99019	52
9	22 48	37 12	32319	9	67681	33303	9	66697	00984	0	99016	51
10	10 22 40	1 37 20	9. 32378	10	10. 67622	9. 33365	10	10. 66635	10. 00987	0	9. 99013	50
11	22 32	37 28	32437	10	67563	33426	11	66574	00989	1	99011	49
12	22 24	37 36	32495	11	67505	33487	12	66513	00992	1	99008	48
13	22 16	37 44	32553	12	67447	33548	13	66452	00995	1	99005	47
14	22 8	37 52	32612	13	67388	33609	14	66391	00998	1	99002	46
15	10 22 0	1 38 0	9. 32670	14	10. 67330	9. 33670	15	10. 66330	10. 01000	1	9. 99000	45
16	21 52	38 8	32728	15	67272	33731	16	66269	01003	1	98997	44
17	21 44	38 16	32786	16	67214	33792	17	66208	01006	1	98994	43
18	21 36	38 24	32844	17	67156	33853	18	66147	01009	1	98991	42
19	21 28	38 32	32902	18	67098	33913	19	66087	01011	1	98989	41
20	10 21 20	1 38 40	9. 32960	19	10. 67040	9. 33974	20	10. 66026	10. 01014	1	9. 98986	40
21	21 12	38 48	33018	20	66982	34034	21	65966	01017	1	98983	39
22	21 4	38 56	33075	21	66925	34095	22	65905	01020	1	98980	38
23	20 56	39 4	33133	22	66867	34155	23	65845	01022	1	98978	37
24	20 48	39 12	33190	23	66810	34215	24	65785	01025	1	98975	36
25	10 20 40	1 39 20	9. 33248	24	10. 66752	9. 34276	25	10. 65724	10. 01028	1	9. 98972	35
26	20 32	39 28	33305	25	66695	34336	26	65664	01031	1	98969	34
27	20 24	39 36	33362	26	66638	34396	27	65604	01033	1	98967	33
28	20 16	39 44	33420	27	66580	34456	28	65544	01036	1	98964	32
29	20 8	39 52	33477	28	66523	34516	29	65484	01039	1	98961	31
30	10 20 0	1 40 0	9. 33534	29	10. 66466	9. 34576	30	10. 65424	10. 01042	1	9. 98958	30
31	19 52	40 8	33591	29	66409	34635	31	65365	01045	1	98955	29
32	19 44	40 16	33647	30	66353	34695	32	65305	01047	1	98953	28
33	19 36	40 24	33704	31	66296	34755	33	65245	01050	2	98950	27
34	19 28	40 32	33761	32	66239	34814	34	65186	01053	2	98947	26
35	10 19 20	1 40 40	9. 33818	33	10. 66182	9. 34874	35	10. 65126	10. 01056	2	9. 98944	25
36	19 12	40 48	33874	34	66126	34933	36	65067	01059	2	98941	24
37	19 4	40 56	33931	35	66069	34992	37	65008	01062	2	98938	23
38	18 56	41 4	33987	36	66013	35051	38	64949	01064	2	98936	22
39	18 48	41 12	34043	37	65957	35111	39	64889	01067	2	98933	21
40	10 18 40	1 41 20	9. 34100	38	10. 65900	9. 35170	40	10. 64830	10. 01070	2	9. 98930	20
41	18 32	41 28	34156	39	65844	35229	41	64771	01073	2	98927	19
42	18 24	41 36	34212	40	65788	35288	42	64712	01076	2	98924	18
43	18 16	41 44	34268	41	65732	35347	43	64653	01079	2	98921	17
44	18 8	41 52	34324	42	65676	35405	44	64595	01081	2	98919	16
45	10 18 0	1 42 0	9. 34380	43	10. 65620	9. 35464	45	10. 64536	10. 01084	2	9. 98916	15
46	17 52	42 8	34436	44	65564	35523	46	64477	01087	2	98913	14
47	17 44	42 16	34491	45	65509	35581	47	64419	01090	2	98910	13
48	17 36	42 24	34547	46	65453	35640	48	64360	01093	2	98907	12
49	17 28	42 32	34602	47	65398	35698	49	64302	01096	2	98904	11
50	10 17 20	1 42 40	9. 34658	48	10. 65342	9. 35757	50	10. 64243	10. 01099	2	9. 98901	10
51	17 12	42 48	34713	48	65287	35815	51	64185	01102	2	98898	9
52	17 4	42 56	34769	49	65231	35873	52	64127	01104	2	98896	8
53	16 56	43 4	34824	50	65176	35931	53	64069	01107	2	98893	7
54	16 48	43 12	34879	51	65121	35989	54	64011	01110	3	98890	6
55	10 16 40	1 43 20	9. 34934	52	10. 65066	9. 36047	55	10. 63953	10. 01113	3	9. 98887	5
56	16 32	43 28	34989	53	65011	36105	56	63895	01116	3	98884	4
57	16 24	43 36	35044	54	64956	36163	57	63837	01119	3	98881	3
58	16 16	43 44	35099	55	64901	36221	58	63779	01122	3	98878	2
59	16 8	43 52	35154	56	64846	36279	59	63721	01125	3	98875	1
60	16 0	44 0	35209	57	64791	36336	60	63664	01128	3	98872	0
M.	Hour P. M.	Hour A. M.	Cosine.	Diff.	Secant.	Cotangent.	Diff.	Tangent.	Cosecant.	Diff.	Sine.	M.
102°											77°	

13° 166°

M.	Hour A M.	Hour P. M.	Sine.	Diff.	Cosecant.	Tangent.	Diff.	Cotangent.	Secant.	Diff.	Cosine.	M.
0	10 16 0	1 44 0	9. 35209	0	10. 64791	9. 36336	0	10. 63664	10. 01128	0	9. 98872	60
1	15 52	44 8	35263	1	64737	36394	1	63606	01131	0	98869	59
2	15 44	44 16	35318	2	64682	36452	2	63548	01133	0	98867	58
3	15 36	44 24	35373	3	64627	36509	3	63491	01136	0	98864	57
4	15 28	44 32	35427	4	64573	36566	4	63434	01139	0	98861	56
5	10 15 20	1 44 40	9. 35481	4	10. 64519	9. 36624	5	10. 63376	10. 01142	0	9. 98858	55
6	15 12	44 48	35536	5	64464	36681	6	63319	01145	0	98855	54
7	15 4	44 56	35590	6	64410	36738	6	63262	01148	0	98852	53
8	14 56	45 4	35644	7	64356	36795	7	63205	01151	0	98849	52
9	14 48	45 12	35698	8	64302	36852	8	63148	01154	0	98846	51
10	10 14 40	1 45 20	9. 35752	9	10. 64248	9. 36909	9	10. 63091	10. 01157	1	9. 98843	50
11	14 32	45 28	35806	10	64194	36966	10	63034	01160	1	98840	49
12	14 24	45 36	35860	11	64140	37023	11	62977	01163	1	98837	48
13	14 16	45 44	35914	11	64086	37080	11	62920	01166	1	98834	47
14	14 8	45 52	35968	12	64032	37137	12	62863	01169	1	98831	46
15	10 14 0	1 46 0	9. 36022	13	10. 63978	9. 37193	14	10. 62807	10. 01172	1	9. 98828	45
16	13 52	46 8	36075	14	63925	37250	15	62750	01175	1	98825	44
17	13 44	46 16	36129	15	63871	37306	16	62694	01178	1	98822	43
18	13 36	46 24	36182	16	63818	37363	17	62637	01181	1	98819	42
19	13 28	46 32	36236	17	63764	37419	18	62581	01184	1	98816	41
20	10 13 20	1 46 40	9. 36289	18	10. 63711	9. 37476	19	10. 62524	10. 01187	1	9. 98813	40
21	13 12	46 48	36342	18	63658	37532	19	62468	01190	1	98810	39
22	13 4	46 56	36395	19	63605	37588	20	62412	01193	1	98807	38
23	12 56	47 4	36449	20	63551	37644	21	62356	01196	1	98804	37
24	12 48	47 12	36502	21	63498	37700	22	62300	01199	1	98801	36
25	10 12 40	1 47 20	9. 36555	22	10. 63445	9. 37756	23	10. 62244	10. 01202	1	9. 98798	35
26	12 32	47 28	36608	23	63392	37812	24	62188	01205	1	98795	34
27	12 24	47 36	36660	24	63340	37868	25	62132	01208	1	98792	33
28	12 16	47 44	36713	25	63287	37924	26	62076	01211	1	98789	32
29	12 8	47 52	36766	25	63234	37980	27	62020	01214	1	98786	31
30	10 12 0	1 48 0	9. 36819	26	10. 63181	9. 38035	28	10. 61965	10. 01217	2	9. 98783	30
31	11 52	48 8	36871	27	63129	38091	29	61909	01220	2	98780	29
32	11 44	48 16	36924	28	63076	38147	30	61853	01223	2	98777	28
33	11 36	48 24	36976	29	63024	38202	31	61798	01226	2	98774	27
34	11 28	48 32	37028	30	62972	38257	32	61743	01229	2	98771	26
35	10 11 20	1 48 40	9. 37081	31	10. 62919	9. 38313	32	10. 61687	10. 01232	2	9. 98768	25
36	11 12	48 48	37133	32	62867	38368	33	61632	01235	2	98765	24
37	11 4	48 56	37185	32	62815	38423	34	61577	01238	2	98762	23
38	10 56	49 4	37237	33	62763	38479	35	61521	01241	2	98759	22
39	10 48	49 12	37289	34	62711	38534	36	61466	01244	2	98756	21
40	10 10 40	1 49 20	9. 37341	35	10. 62659	9. 38589	37	10. 61411	10. 01247	2	9. 98753	20
41	10 32	49 28	37393	36	62607	38644	38	61356	01250	2	98750	19
42	10 24	49 36	37445	37	62555	38699	39	61301	01254	2	98746	18
43	10 16	49 44	37497	38	62503	38754	40	61246	01257	2	98743	17
44	10 8	49 52	37549	39	62451	38808	41	61192	01260	2	98740	16
45	10 10 0	1 50 0	9. 37600	39	10. 62400	9. 38863	42	10. 61137	10. 01263	2	9. 98737	15
46	9 52	50 8	37652	40	62348	38918	43	61082	01266	2	98734	14
47	9 44	50 16	37703	41	62297	38972	44	61028	01269	2	98731	13
48	9 36	50 24	37755	42	62245	39027	45	60973	01272	2	98728	12
49	9 28	50 32	37806	43	62194	39082	45	60918	01275	2	98725	11
50	10 9 20	1 50 40	9. 37858	44	10. 62142	9. 39136	46	10. 60864	10. 01278	3	9. 98722	10
51	9 12	50 48	37909	45	62091	39190	47	60810	01281	3	98719	9
52	9 4	50 56	37960	46	62040	39245	48	60755	01285	3	98715	8
53	8 56	51 4	38011	47	61989	39299	49	60701	01288	3	98712	7
54	8 48	51 12	38062	47	61938	39353	50	60647	01291	3	98709	6
55	10 8 40	1 51 20	9. 38113	48	10. 61887	9. 39407	51	10. 60593	10. 01294	3	9. 98706	5
56	8 32	51 28	38164	49	61836	39461	52	60539	01297	3	98703	4
57	8 24	51 36	38215	50	61785	39515	53	60485	01300	3	98700	3
58	8 16	51 44	38266	51	61734	39569	54	60431	01303	3	98697	2
59	8 8	51 52	38317	52	61683	39623	55	60377	01306	3	98694	1
60	8 0	52 0	38368	53	61632	39677	56	60323	01310	3	98690	0
M.	Hour P. M.	Hour A. M.	Cosine.	Diff.	Secant.	Cotangent.	Diff.	Tangent.	Cosecant.	Diff.	Sine.	M.

103° 76°

SINES, TANGENTS, AND SECANTS.

14°												165°
M.	Hour A. M.	Hour P. M.	Sine.	Diff.	Cosecant.	Tangent.	Diff.	Cotangent.	Secant.	Diff.	Cosine.	M
0	10 8 0	1 52 0	9. 38368	0	10. 61632	9. 39677	0	10. 60323	10. 01310	0	9. 98690	60
1	7 52	52 8	38418	1	61582	39731	1	60269	01313	0	98687	59
2	7 44	52 16	38469	2	61531	39785	2	60215	01316	0	98684	58
3	7 36	52 24	38519	2	61481	39838	3	60162	01319	0	98681	57
4	7 28	52 32	38570	3	61430	39892	3	60108	01322	0	98678	56
5	10 7 20	1 52 40	9. 38620	4	10. 61380	9. 39945	4	10. 60055	10. 01325	0	9. 98675	55
6	7 12	52 48	38670	5	61330	39999	5	60001	01329	0	98671	54
7	7 4	52 56	38721	6	61279	40052	6	59948	01332	0	98668	53
8	6 56	53 4	38771	7	61229	40106	7	59894	01335	0	98665	52
9	6 48	53 12	38821	7	61179	40159	8	59841	01338	0	98662	51
10	10 6 40	1 53 20	9. 38871	8	10. 61129	9. 40212	9	10. 59788	10. 01341	1	9. 98659	50
11	6 32	53 28	38921	9	61079	40266	10	59734	01344	1	98656	49
12	6 24	53 36	38971	10	61029	40319	10	59681	01348	1	98652	48
13	6 16	53 44	39021	11	60979	40372	11	59628	01351	1	98649	47
14	6 8	53 52	39071	11	60929	40425	12	59575	01354	1	98646	46
15	10 6 0	1 54 0	9. 39121	12	10. 60879	9. 40478	13	10. 59522	10. 01357	1	9. 98643	45
16	5 52	54 8	39170	13	60830	40531	14	59469	01360	1	98640	44
17	5 44	54 16	39220	14	60780	40584	15	59416	01364	1	98636	43
18	5 36	54 24	39270	15	60730	40636	16	59364	01367	1	98633	42
19	5 28	54 32	39319	15	60681	40689	17	59311	01370	1	98630	41
20	10 5 20	1 54 40	9. 39369	16	10. 60631	9. 40742	17	10. 59258	10. 01373	1	9. 98627	40
21	5 12	54 48	39418	17	60582	40795	18	59205	01377	1	98623	39
22	5 4	54 56	39467	18	60533	40847	19	59153	01380	1	98620	38
23	4 56	55 4	39517	19	60483	40900	20	59100	01383	1	98617	37
24	4 48	55 12	39566	20	60434	40952	21	59048	01386	1	98614	36
25	10 4 40	1 55 20	9. 39615	20	10. 60385	9. 41005	22	10. 58995	10. 01390	1	9. 98610	35
26	4 32	55 28	39664	21	60336	41057	23	58943	01393	1	98607	34
27	4 24	55 36	39713	22	60287	41109	23	58891	01396	1	98604	33
28	4 16	55 44	39762	23	60238	41161	24	58839	01399	2	98601	32
29	4 8	55 52	39811	24	60189	41214	25	58786	01403	2	98597	31
30	10 4 0	1 56 0	9. 39860	24	10. 60140	9. 41266	26	10. 58734	10. 01406	2	9. 98594	30
31	3 52	56 8	39909	25	60091	41318	27	58682	01409	2	98591	29
32	3 44	56 16	39958	26	60042	41370	28	58630	01412	2	98588	28
33	3 36	56 24	40006	27	59994	41422	29	58578	01416	2	98584	27
34	3 28	56 32	40055	28	59945	41474	30	58526	01419	2	98581	26
35	10 3 20	1 56 40	9. 40103	29	10. 59897	9. 41526	30	10. 58474	10. 01422	2	9. 98578	25
36	3 12	56 48	40152	29	59848	41578	31	58422	01426	2	98574	24
37	3 4	56 56	40200	30	59800	41629	32	58371	01429	2	98571	23
38	2 56	57 4	40249	31	59751	41681	33	58319	01432	2	98568	22
39	2 48	57 12	40297	32	59703	41733	34	58267	01435	2	98565	21
40	10 2 40	1 57 20	9. 40346	33	10. 59654	9. 41785	35	10. 58216	10. 01439	2	9. 98561	20
41	2 32	57 28	40394	33	59606	41836	36	58164	01442	2	98558	19
42	2 24	57 36	40442	34	59558	41887	36	58113	01445	2	98555	18
43	2 16	57 44	40490	35	59510	41939	37	58061	01449	2	98551	17
44	2 8	57 52	40538	36	59462	41990	38	58010	01452	2	98548	16
45	10 2 0	1 58 0	9. 40586	37	10. 59414	9. 42041	39	10. 57959	10. 01455	2	9. 98545	15
46	1 52	58 8	40634	37	59366	42093	40	57907	01459	3	98541	14
47	1 44	58 16	40682	38	59318	42144	41	57856	01462	3	98538	13
48	1 36	58 24	40730	39	59270	42195	42	57805	01465	3	98535	12
49	1 28	58 32	40778	40	59222	42246	43	57754	01469	3	98531	11
50	10 1 20	1 58 40	9. 40825	41	10. 59175	9. 42297	43	10. 57703	10. 01472	3	9. 98528	10
51	1 12	58 48	40873	42	59127	42348	44	57652	01475	3	98525	9
52	1 4	58 56	40921	42	59079	42399	45	57601	01479	3	98521	8
53	0 56	59 4	40968	43	59032	42450	46	57550	01482	3	98518	7
54	0 48	59 12	41016	44	58984	42501	47	57499	01485	3	98515	6
55	10 0 40	1 59 20	9. 41063	45	10. 58937	9. 42552	48	10. 57448	10. 01489	3	9. 98511	5
56	0 32	59 28	41111	46	58889	42603	49	57397	01492	3	98508	4
57	0 24	59 36	41158	46	58842	42653	50	57347	01495	3	98505	3
58	0 16	59 44	41205	47	58795	42704	50	57296	01499	3	98501	2
59	0 8	59 52	41252	48	58748	42755	51	57245	01502	3	98498	1
60	0 0	2 0 0	41300	49	58700	42805	52	57195	01506	3	98494	0
M.	Hour P. M.	Hour A. M.	Cosine.	Diff.	Secant.	Cotangent.	Diff.	Tangent.	Cosecant.	Diff.	Sine.	M
101°												75°

SINES, TANGENTS, AND SECANTS.

15° — 164°

M.	Hour A. M.	Hour P. M.	Sine.	Diff.	Cosecant.	Tangent.	Diff.	Cotangent.	Secant.	Diff.	Cosine.	M.
0	10 0 0	2 0 0	9. 41300	0	10. 58700	9. 42805	0	10. 57195	10. 01506	0	9. 98494	60
1	9 59 52	0 8	41347	1	58653	42856	1	57144	01509	0	98491	59
2	59 44	0 16	41394	2	58606	42906	2	57094	01512	0	98488	58
3	59 36	0 24	41441	2	58559	42957	2	57043	01516	0	98484	57
4	59 28	0 32	41488	3	58512	43007	3	56993	01519	0	98481	56
5	9 59 20	2 0 40	9. 41535	4	10. 58465	9. 43057	4	10. 56943	10. 01523	0	9. 98477	55
6	59 12	0 48	41582	5	58418	43108	5	56892	01526	0	98474	54
7	59 4	0 56	41628	5	58372	43158	6	56842	01529	0	98471	53
8	58 56	1 4	41675	6	58325	43208	7	56792	01533	0	98467	52
9	58 48	1 12	41722	7	58278	43258	7	56742	01536	1	98464	51
10	9 58 40	2 1 20	9. 41768	8	10. 58232	9. 43308	8	10. 56692	10. 01540	1	9. 98460	50
11	58 32	1 28	41815	8	58185	43358	9	56642	01543	1	98457	49
12	58 24	1 36	41861	9	58139	43408	10	56592	01547	1	98453	48
13	58 16	1 44	41908	10	58092	43458	11	56542	01550	1	98450	47
14	58 8	1 52	41954	11	58046	43508	11	56492	01553	1	98447	46
15	9 58 0	2 2 0	9. 42001	11	10. 57999	9. 43558	12	10. 56442	10. 01557	1	9. 98443	45
16	57 52	2 8	42047	12	57953	43607	13	56393	01560	1	98440	44
17	57 44	2 16	42093	13	57907	43657	14	56343	01564	1	98436	43
18	57 36	2 24	42140	14	57860	43707	15	56293	01567	1	98433	42
19	57 28	2 32	42186	14	57814	43756	16	56244	01571	1	98429	41
20	9 57 20	2 2 40	9. 42232	15	10. 57768	9. 43806	16	10. 56194	10. 01574	1	9. 98426	40
21	57 12	2 48	42278	16	57722	43855	17	56145	01578	1	98422	39
22	57 4	2 56	42324	17	57676	43905	18	56095	01581	1	98419	38
23	56 56	3 4	42370	17	57630	43954	19	56046	01585	1	98415	37
24	56 48	3 12	42416	18	57584	44004	20	55996	01588	1	98412	36
25	9 56 40	2 3 20	9. 42461	19	10. 57539	9. 44053	20	10. 55947	10. 01591	1	9. 98409	35
26	56 32	3 28	42507	20	57493	44102	21	55898	01595	2	98405	34
27	56 24	3 36	42553	21	57447	44151	22	55849	01598	2	98402	33
28	56 16	3 44	42599	21	57401	44201	23	55799	01602	2	98398	32
29	56 8	3 52	42644	22	57356	44250	24	55750	01605	2	98395	31
30	9 56 0	2 4 0	9. 42690	23	10. 57310	9. 44299	25	10. 55701	10. 01609	2	9. 98391	30
31	55 52	4 8	42735	24	57265	44348	25	55652	01612	2	98388	29
32	55 44	4 16	42781	24	57219	44397	26	55603	01616	2	98384	28
33	55 36	4 24	42826	25	57174	44446	27	55554	01619	2	98381	27
34	55 28	4 32	42872	26	57128	44495	28	55505	01623	2	98377	26
35	9 55 20	2 4 40	9. 42917	27	10. 57083	9. 44544	29	10. 55456	10. 01627	2	9. 98373	25
36	55 12	4 48	42962	27	57038	44592	29	55408	01630	2	98370	24
37	55 4	4 56	43008	28	56992	44641	30	55359	01634	2	98366	23
38	54 56	5 4	43053	29	56947	44690	31	55310	01637	2	98363	22
39	54 48	5 12	43098	30	56902	44738	32	55262	01641	2	98359	21
40	9 54 40	2 5 20	9. 43143	30	10. 56857	9. 44787	33	10. 55213	10. 01644	2	9. 98356	20
41	54 32	5 28	43188	31	56812	44836	34	55164	01648	2	98352	19
42	54 24	5 36	43233	32	56767	44884	34	55116	01651	2	98349	18
43	54 16	5 44	43278	33	56722	44933	35	55067	01655	3	98345	17
44	54 8	5 52	43323	33	56677	44981	36	55019	01658	3	98342	16
45	9 54 0	2 6 0	9. 43367	34	10. 56633	9. 45029	37	10. 54971	10. 01662	3	9. 98338	15
46	53 52	6 8	43412	35	56588	45078	38	54922	01666	3	98334	14
47	53 44	6 16	43457	36	56543	45126	38	54874	01669	3	98331	13
48	53 36	6 24	43502	36	56498	45174	39	54826	01673	3	98327	12
49	53 28	6 32	43546	37	56454	45222	40	54778	01676	3	98324	11
50	9 53 20	2 6 40	9. 43591	38	10. 56409	9. 45271	41	10. 54729	10. 01680	3	9. 98320	10
51	53 12	6 48	43635	39	56365	45319	42	54681	01683	3	98317	9
52	53 4	6 56	43680	39	56320	45367	43	54633	01687	3	98313	8
53	52 56	7 4	43724	40	56276	45415	43	54585	01691	3	98309	7
54	52 48	7 12	43769	41	56231	45463	44	54537	01694	3	98306	6
55	9 52 40	2 7 20	9. 43813	42	10. 56187	9. 45511	45	10. 54489	10. 01698	3	9. 98302	5
56	52 32	7 28	43857	43	56143	45559	46	54441	01701	3	98299	4
57	52 24	7 36	43901	43	56099	45606	47	54394	01705	3	98295	3
58	52 16	7 44	43946	44	56054	45654	47	54346	01709	3	98291	2
59	52 8	7 52	43990	45	56010	45702	48	54298	01712	3	98288	1
60	52 0	8 0	44034	46	55966	45750	49	54250	01716	4	98284	0
M.	Hour P. M.	Hour A. M.	Cosine.	Diff.	Secant.	Cotangent.	Diff.	Tangent.	Cosecant.	Diff.	Sine.	M.

105° — 74°

SINES, TANGENTS, AND SECANTS.

16°													163°
M.	Hour A. M.	Hour P. M.	Sine.	Diff.	Cosecant.	Tangent.	Diff.	Cotangent.	Secant.	Diff.	Cosine.	M.
0	9 52 0	2 8 0	9. 44034	0	10. 55966	9. 45750	0	10. 54250	10. 01716	0	9. 98284	60
1	51 52	8 8	44078	1	55922	45797	1	54203	01719	0	98281	59
2	51 44	8 16	44122	1	55878	45845	2	54155	01723	0	98277	58
3	51 36	8 24	44166	2	55834	45892	2	54108	01727	0	98273	57
4	51 28	8 32	44210	3	55790	45940	3	54060	01730	0	98270	56
5	9 51 20	2 8 40	9. 44253	4	10. 55747	9. 45987	4	10. 54013	10. 01734	0	9. 98266	55
6	51 12	8 48	44297	4	55703	46035	5	53965	01738	0	98262	54
7	51 4	8 56	44341	5	55659	46082	5	53918	01741	0	98259	53
8	50 56	9 4	44385	6	55615	46130	6	53870	01745	0	98255	52
9	50 48	9 12	44428	6	55572	46177	7	53823	01749	1	98251	51
10	9 50 40	2 9 20	9. 44472	7	10. 55528	9. 46224	8	10. 53776	10. 01752	1	9. 98248	50
11	50 32	9 28	44516	8	55484	46271	9	53729	01756	1	98244	49
12	50 24	9 36	44559	9	55441	46319	9	53681	01760	1	98240	48
13	50 16	9 44	44602	9	55398	46366	10	53634	01763	1	98237	47
14	50 8	9 52	44646	10	55354	46413	11	53587	01767	1	98233	46
15	9 50 0	2 10 0	9. 44689	11	10. 55311	9. 46460	12	10. 53540	10. 01771	1	9. 98229	45
16	49 52	10 8	44733	11	55267	46507	12	53493	01774	1	98226	44
17	49 44	10 16	44776	12	55224	46554	13	53446	01778	1	98222	43
18	49 36	10 24	44819	13	55181	46601	14	53399	01782	1	98218	42
19	49 28	10 32	44862	14	55138	46648	15	53352	01785	1	98215	41
20	9 49 20	2 10 40	9. 44905	14	10. 55095	9. 46694	15	10. 53306	10. 01789	1	9. 98211	40
21	49 12	10 48	44948	15	55052	46741	16	53259	01793	1	98207	39
22	49 4	10 56	44992	16	55008	46788	17	53212	01796	1	98204	38
23	48 56	11 4	45035	16	54965	46835	18	53165	01800	1	98200	37
24	48 48	11 12	45077	17	54923	46881	19	53119	01804	1	98196	36
25	9 48 40	2 11 20	9. 45120	18	10. 54880	9. 46928	19	10. 53072	10. 01808	2	9. 98192	35
26	48 32	11 28	45163	18	54837	46975	20	53025	01811	2	98189	34
27	48 24	11 36	45206	19	54794	47021	21	52979	01815	2	98185	33
28	48 16	11 44	45249	20	54751	47068	22	52932	01819	2	98181	32
29	48 8	11 52	45292	21	54708	47114	22	52886	01823	2	98177	31
30	9 48 0	2 12 0	9. 45334	21	10. 54666	9. 47160	23	10. 52840	10. 01826	2	9. 98174	30
31	47 52	12 8	45377	22	54623	47207	24	52793	01830	2	98170	29
32	47 44	12 16	45419	23	54581	47253	25	52747	01834	2	98166	28
33	47 36	12 24	45462	23	54538	47299	26	52701	01838	2	98162	27
34	47 28	12 32	45504	24	54496	47346	26	52654	01841	2	98159	26
35	9 47 20	2 12 40	9. 45547	25	10. 54453	9. 47392	27	10. 52608	10. 01845	2	9. 98155	25
36	47 12	12 48	45589	26	54411	47438	28	52562	01849	2	98151	24
37	47 4	12 56	45632	26	54368	47484	29	52516	01853	2	98147	23
38	46 56	13 4	45674	27	54326	47530	29	52470	01856	2	98144	22
39	46 48	13 12	45716	28	54284	47576	30	52424	01860	2	98140	21
40	9 46 40	2 13 20	9. 45758	28	10. 54242	9. 47622	31	10. 52378	10. 01864	3	9. 98136	20
41	46 32	13 28	45801	29	54199	47668	32	52332	01868	3	98132	19
42	46 24	13 36	45843	30	54157	47714	32	52286	01871	3	98129	18
43	46 16	13 44	45885	31	54115	47760	33	52240	01875	3	98125	17
44	46 8	13 52	45927	31	54073	47806	34	52194	01879	3	98121	16
45	9 46 0	2 14 0	9. 45969	32	10. 54031	9. 47852	35	10. 52148	10. 01883	3	9. 98117	15
46	45 52	14 8	46011	33	53989	47897	36	52103	01887	3	98113	14
47	45 44	14 16	46053	33	53947	47943	36	52057	01890	3	98110	13
48	45 36	14 24	46095	34	53905	47989	37	52011	01894	3	98106	12
49	45 28	14 32	46136	35	53864	48035	38	51965	01898	3	98102	11
50	9 45 20	2 14 40	9. 46178	36	10. 53822	9. 48082	39	10. 51920	10. 01902	3	9. 98098	10
51	45 12	14 48	46220	36	53780	48126	39	51874	01906	3	98094	9
52	45 4	14 56	46262	37	53738	48171	40	51829	01910	3	98090	8
53	44 56	15 4	46303	38	53697	48217	41	51783	01913	3	98087	7
54	44 48	15 12	46345	38	53655	48262	42	51738	01917	3	98083	6
55	9 44 40	2 15 20	9. 46386	39	10. 53614	9. 48307	43	10. 51693	10. 01921	3	9. 98079	5
56	44 32	15 28	46428	40	53572	48353	43	51647	01925	3	98075	4
57	44 24	15 36	46469	41	53531	48398	44	51602	01929	4	98071	3
58	44 16	15 44	46511	41	53489	48443	45	51557	01933	4	98067	2
59	44 8	15 52	46552	42	53448	48489	46	51511	01937	4	98063	1
60	44 0	16 0	46594	43	53406	48534	46	51466	01940	4	98060	0
M.	Hour P. M.	Hour A. M.	Cosine.	Diff.	Secant.	Cotangent.	Diff.	Tangent.	Cosecant.	Diff.	Sine.	M.
106°												73°

17°												162°
M.	Hour A. M.	Hour P. M.	Sine.	Diff.	Cosecant.	Tangent.	Diff.	Cotangent.	Secant.	Diff.	Cosine.	M.
0	9 44 0	2 16 0	9. 46594	0	10. 53406	9. 48534	0	10. 51466	10. 01940	0	9. 98060	60
1	43 52	16 8	46635	1	53365	48579	1	51421	01944	0	98056	59
2	43 44	16 16	46676	1	53324	48624	1	51376	01948	0	98052	58
3	43 36	16 24	46717	2	53283	48669	2	51331	01952	0	98048	57
4	43 28	16 32	46758	3	53242	48714	3	51286	01956	0	98044	56
5	9 43 20	2 16 40	9. 40800	3	10. 53200	9. 48759	4	10. 51241	10. 01960	0	9. 98040	55
6	43 12	16 48	46841	4	53159	48804	4	51196	01964	0	98036	54
7	43 4	16 56	46882	5	53118	48849	5	51151	01968	0	98032	53
8	42 56	17 4	46923	5	53077	48894	6	51106	01971	1	98029	52
9	42 48	17 12	46964	6	53036	48939	7	51061	01975	1	98025	51
10	9 42 40	2 17 20	9. 47005	7	10. 52995	9. 48984	7	10. 51016	10. 01979	1	9. 98021	50
11	42 32	17 28	47045	7	52955	49029	8	50971	01983	1	98017	49
12	42 24	17 36	47086	8	52914	49073	9	50927	01987	1	98013	48
13	42 16	17 44	47127	9	52873	49118	10	50882	01991	1	98009	47
14	42 8	17 52	47168	9	52832	49163	10	50837	01995	1	98005	46
15	9 42 0	2 18 0	9. 47209	10	10. 52791	9. 49207	11	10. 50793	10. 01999	1	9. 98001	45
16	41 52	18 8	47249	11	52751	49252	12	50748	02003	1	97997	44
17	41 44	18 16	47290	11	52710	49296	12	50704	02007	1	97993	43
18	41 36	18 24	47330	12	52670	49341	13	50659	02011	1	97989	42
19	41 28	18 32	47371	13	52629	49385	14	50615	02014	1	97986	41
20	9 41 20	2 18 40	9. 47411	13	10. 52589	9. 49430	15	10. 50570	10. 02018	1	9. 97982	40
21	41 12	18 48	47452	14	52548	49474	15	50526	02022	1	97978	39
22	41 4	18 56	47492	15	52508	49519	16	50481	02026	1	97974	38
23	40 56	19 4	47533	15	52467	49563	17	50437	02030	2	97970	37
24	40 48	19 12	47573	16	52427	49607	18	50393	02034	2	97966	36
25	9 40 40	2 19 20	9. 47613	17	10. 52387	9. 49652	18	10. 50348	10. 02038	2	9. 97962	35
26	40 32	19 28	47654	17	52346	49696	19	50304	02042	2	97958	34
27	40 24	19 36	47694	18	52306	49740	20	50260	02046	2	97954	33
28	40 16	19 44	47734	19	52266	49784	21	50216	02050	2	97950	32
29	40 8	19 52	47774	19	52226	49828	21	50172	02054	2	97946	31
30	9 40 0	2 20 0	9. 47814	20	10. 52186	9. 49872	22	10. 50128	10. 02058	2	9. 97942	30
31	39 52	20 8	47854	21	52146	49916	23	50084	02062	2	97938	29
32	39 44	20 16	47894	21	52106	49960	24	50040	02066	2	97934	28
33	39 36	20 24	47934	22	52066	50004	24	49996	02070	2	97930	27
34	39 28	20 32	47974	23	52026	50048	25	49952	02074	2	97926	26
35	9 39 20	2 20 40	9. 48014	23	10. 51986	9. 50092	26	10. 49908	10. 02078	2	9. 97922	25
36	39 12	20 48	48054	24	51946	50136	26	49864	02082	2	97918	24
37	39 4	20 56	48094	25	51906	50180	27	49820	02086	2	97914	23
38	38 56	21 4	48133	25	51867	50223	28	49777	02090	3	97910	22
39	38 48	21 12	48173	26	51827	50267	29	49733	02094	3	97906	21
40	9 38 40	2 21 20	9. 48213	27	10. 51787	9. 50311	29	10. 49689	10. 02098	3	9. 97902	20
41	38 32	21 28	48252	27	51748	50355	30	49645	02102	3	97898	19
42	38 24	21 36	48292	28	51708	50398	31	49602	02106	3	97894	18
43	38 16	21 44	48332	29	51668	50442	32	49558	02110	3	97890	17
44	38 8	21 52	48371	29	51629	50485	32	49515	02114	3	97886	16
45	9 38 0	2 22 0	9. 48411	30	10. 51589	9. 50529	33	10. 49471	10. 02118	3	9. 97882	15
46	37 52	22 8	48450	31	51550	50572	34	49428	02122	3	97878	14
47	37 44	22 16	48490	31	51510	50616	35	49384	02126	3	97874	13
48	37 36	22 24	48529	32	51471	50659	35	49341	02130	3	97870	12
49	37 28	22 32	48568	33	51432	50703	36	49297	02134	3	97866	11
50	9 37 20	2 22 40	9. 48607	33	10. 51393	9. 50746	37	10. 49254	10. 02139	3	9. 97861	10
51	37 12	22 48	48647	34	51353	50789	37	49211	02143	3	97857	9
52	37 4	22 56	48686	35	51314	50833	38	49167	02147	3	97853	8
53	36 56	23 4	48725	35	51275	50876	39	49124	02151	4	97849	7
54	36 48	23 12	48764	36	51236	50919	40	49081	02155	4	97845	6
55	9 36 40	2 23 20	9. 48803	37	10. 51197	9. 50962	40	10. 49038	10. 02159	4	9. 97841	5
56	36 32	23 28	48842	37	51158	51005	41	48995	02163	4	97837	4
57	36 24	23 36	48881	38	51119	51048	42	48952	02167	4	97833	3
58	36 16	23 44	48920	39	51080	51092	43	48908	02171	4	97829	2
59	36 8	23 52	48959	39	51041	51135	43	48865	02175	4	97825	1
60	36 0	24 0	48998	40	51002	51178	44	48822	02179	4	97821	0
M.	Hour P. M.	Hour A. M.	Cosine.	Diff.	Secant.	Cotangent.	Diff.	Tangent.	Cosecant.	Diff.	Sine.	M.
107°												72°

SINES, TANGENTS, AND SECANTS.

19°											161°
M.	Hour A. M.	Hour P. M.	Sine.	Diff.	Cosecant.	Tangent.	Diff.	Cotangent.	Secant.	Diff.	Cosine.	M.
0	9 36 0	2 24 0	9. 48998	0	10. 51002	9. 51178	0	10. 48822	10. 02179	0	9. 97821	60
1	35 52	24 8	49037	1	50963	51221	1	48779	02183	0	97817	59
2	35 44	24 16	49076	1	50924	51264	1	48736	02188	0	97812	58
3	35 36	24 24	49115	2	50885	51306	2	48694	02192	0	97808	57
4	35 28	24 32	49153	3	50847	51349	3	48651	02196	0	97804	56
5	9 35 20	2 24 40	9. 49192	3	10. 50808	9. 51392	3	10. 48608	10. 02200	0	9. 97800	55
6	35 12	24 48	49231	4	50769	51435	4	48565	02204	0	97796	54
7	35 4	24 56	49269	4	50731	51478	5	48522	02208	0	97792	53
8	34 56	25 4	49308	5	50692	51520	6	48480	02212	1	97788	52
9	34 48	25 12	49347	6	50653	51563	6	48437	02216	1	97784	51
10	9 34 40	2 25 20	9. 49385	6	10. 50615	9. 51606	7	10. 48394	10. 02221	1	9. 97779	50
11	34 32	25 28	49424	7	50576	51648	8	48352	02225	1	97775	49
12	34 24	25 36	49462	8	50538	51691	8	48309	02229	1	97771	48
13	34 16	25 44	49500	8	50500	51734	9	48266	02233	1	97767	47
14	34 8	25 52	49539	9	50461	51776	10	48224	02237	1	97763	46
15	9 34 0	2 26 0	9. 49577	9	10. 50423	9. 51819	10	10. 48181	10. 02241	1	9. 97759	45
16	33 52	26 8	49615	10	50385	51861	11	48139	02246	1	97754	44
17	33 44	26 16	49654	11	50346	51903	12	48097	02250	1	97750	43
18	33 36	26 24	49692	11	50308	51946	13	48054	02254	1	97746	42
19	33 28	26 32	49730	12	50270	51988	13	48012	02258	1	97742	41
20	9 33 20	2 26 40	9. 49768	13	10. 50232	9. 52031	14	10. 47969	10. 02262	1	9. 97738	40
21	33 12	26 48	49806	13	50194	52073	15	47927	02266	1	97734	39
22	33 4	26 56	49844	14	50156	52115	15	47885	02271	2	97729	38
23	32 56	27 4	49882	14	50118	52157	16	47843	02275	2	97725	37
24	32 48	27 12	49920	15	50080	52200	17	47800	02279	2	97721	36
25	9 32 40	2 27 20	9. 49958	16	10. 50042	9. 52242	17	10. 47758	10. 02283	2	9. 97717	35
26	32 32	27 28	49996	16	50004	52284	18	47716	02287	2	97713	34
27	32 24	27 36	50034	17	49966	52326	19	47674	02292	2	97708	33
28	32 16	27 44	50072	18	49928	52368	20	47632	02296	2	97704	32
29	32 8	27 52	50110	18	49890	52410	20	47590	02300	2	97700	31
30	9 32 0	2 28 0	9. 50148	19	10. 49852	9. 52452	21	10. 47548	10. 02304	2	9. 97696	30
31	31 52	28 8	50185	20	49815	52494	22	47506	02309	2	97691	29
32	31 44	28 16	50223	20	49777	52536	22	47464	02313	2	97687	28
33	31 36	28 24	50261	21	49739	52578	23	47422	02317	2	97683	27
34	31 28	28 32	50298	21	49702	52620	24	47380	02321	2	97679	26
35	9 31 20	2 28 40	9. 50336	22	10. 49664	9. 52661	24	10. 47339	10. 02326	2	9. 97674	25
36	31 12	28 48	50374	23	49626	52703	25	47297	02330	3	97670	24
37	31 4	28 56	50411	23	49589	52745	26	47255	02334	3	97666	23
38	30 56	29 4	50449	24	49551	52787	27	47213	02338	3	97662	22
39	30 48	29 12	50486	25	49514	52829	27	47171	02343	3	97657	21
40	9 30 40	2 29 20	9. 50523	25	10. 49477	9. 52870	28	10. 47130	10. 02347	3	9. 97653	20
41	30 32	29 28	50561	26	49439	52912	29	47088	02351	3	97649	19
42	30 24	29 36	50598	26	49402	52953	29	47047	02355	3	97645	18
43	30 16	29 44	50635	27	49365	52995	30	47005	02360	3	97640	17
44	30 8	29 52	50673	28	49327	53037	31	46963	02364	3	97636	16
45	9 30 0	2 30 0	9. 50710	28	10. 49290	9. 53078	31	10. 46922	10. 02368	3	9. 97632	15
46	29 52	30 8	50747	29	49253	53120	32	46880	02372	3	97628	14
47	29 44	30 16	50784	30	49216	53161	33	46839	02377	3	97623	13
48	29 36	30 24	50821	30	49179	53202	34	46798	02381	3	97619	12
49	29 28	30 32	50858	31	49142	53244	34	46756	02385	3	97615	11
50	9 29 20	2 30 40	9. 50896	31	10. 49104	9. 53285	35	10. 46715	10. 02390	4	9. 97610	10
51	29 12	30 48	50933	32	49067	53327	36	46673	02394	4	97606	9
52	29 4	30 56	50970	33	49030	53368	36	46632	02398	4	97602	8
53	28 56	31 4	51007	33	48993	53409	37	46591	02403	4	97597	7
54	28 48	31 12	51043	34	48957	53450	38	46550	02407	4	97593	6
55	9 28 40	2 31 20	9. 51080	35	10. 48920	9. 53492	38	10. 46508	10. 02411	4	9. 97589	5
56	28 32	31 28	51117	35	48883	53533	39	46467	02416	4	97584	4
57	28 24	31 36	51154	36	48846	53574	40	46426	02420	4	97580	3
58	28 16	31 44	51191	37	48809	53615	41	46385	02424	4	97576	2
59	28 8	31 52	51227	37	48773	53656	41	46344	02429	4	97571	1
60	28 0	32 0	51264	38	48736	53697	42	46303	02433	4	97567	0
M.	Hour P. M.	Hour A. M.	Cosine.	Diff.	Secant.	Cotangent.	Diff.	Tangent.	Cosecant.	Diff.	Sine.	M.
108°												71°

19° 160°

M.	Hour A. M.	Hour P. M.	Sine.	Diff.	Cosecant.	Tangent.	Diff.	Cotangent.	Secant.	Diff.	Cosine.	M.
0	9 28 0	2 32 0	9. 51264	0	10. 48736	9. 53697	0	10. 46303	10. 02433	0	9. 97567	60
1	27 52	32 8	51301	1	48699	53738	1	46262	02437	0	97563	59
2	27 44	32 16	51338	1	48662	53779	1	46221	02442	0	97558	58
3	27 36	32 24	51374	2	48626	53820	2	46180	02446	0	97554	57
4	27 28	32 32	51411	2	48589	53861	3	46139	02450	0	97550	56
5	9 27 20	2 32 40	9. 51447	3	10. 48553	9. 53902	3	10. 46098	10. 02455	0	9. 97545	55
6	27 12	32 48	51484	4	48516	53943	4	46057	02459	0	97541	54
7	27 4	32 56	51520	4	48480	53984	5	46016	02464	1	97536	53
8	26 56	33 4	51557	5	48443	54025	5	45975	02468	1	97532	52
9	26 48	33 12	51593	5	48407	54065	6	45935	02472	1	97528	51
10	9 26 40	2 33 20	9. 51629	6	10. 48371	9. 54106	7	10. 45894	10. 02477	1	9. 95523	50
11	26 32	33 28	51666	7	48334	54147	7	45853	02481	1	97519	49
12	26 24	33 36	51702	7	48298	54187	8	45813	02485	1	97515	48
13	26 16	33 44	51738	8	48262	54228	9	45772	02490	1	97510	47
14	26 8	33 52	51774	8	48226	54269	9	45731	02494	1	97506	46
15	9 26 0	2 34 0	9. 51811	9	10. 48189	9. 54309	10	10. 45691	10. 02499	1	9. 97501	45
16	25 52	34 8	51847	10	48153	54350	11	45650	02503	1	97497	44
17	25 44	34 16	51883	10	48117	54390	11	45610	02508	1	97492	43
18	25 36	34 24	51919	11	48081	54431	12	45569	02512	1	97488	42
19	25 28	34 32	51955	11	48045	54471	13	45529	02516	1	97484	41
20	9 25 20	2 34 40	9. 51991	12	10. 48009	9. 54512	13	10. 45488	10. 02521	1	9. 97479	40
21	25 12	34 48	52027	12	47973	54552	14	45448	02525	2	97475	39
22	25 4	34 56	52063	13	47937	54593	15	45407	02530	2	97470	38
23	24 56	35 4	52099	14	47901	54633	15	45367	02534	2	97466	37
24	24 48	35 12	52135	14	47865	54673	16	45327	02539	2	97461	36
25	9 24 40	2 35 20	9. 52171	15	10. 47829	9. 54714	17	10. 45286	10. 02543	2	9. 97457	35
26	24 32	35 28	52207	15	47793	54754	17	45246	02547	2	97453	34
27	24 24	35 36	52242	16	47758	54794	18	45206	02552	2	97448	33
28	24 16	35 44	52278	17	47722	54835	19	45165	02556	2	97444	32
29	24 8	35 52	52314	17	47686	54875	19	45125	02561	2	97439	31
30	9 24 0	2 36 0	9. 52350	18	10. 47650	9. 54915	20	10. 45085	10. 02565	2	9. 97435	30
31	23 52	36 8	52385	18	47615	54955	21	45045	02570	2	97430	29
32	23 44	36 16	52421	19	47579	54995	21	45005	02574	2	97426	28
33	23 36	36 24	52456	20	47544	55035	22	44965	02579	2	97421	27
34	23 28	36 32	52492	20	47508	55075	23	44925	02583	3	97417	26
35	9 23 20	2 36 40	9. 52527	21	10. 47473	9. 55115	23	10. 44885	10. 02588	3	9. 97412	25
36	23 12	36 48	52563	21	47437	55155	24	44845	02592	3	97408	24
37	23 4	36 56	52598	22	47402	55195	25	44805	02597	3	97403	23
38	22 56	37 4	52634	23	47366	55235	25	44765	02601	3	97399	22
39	22 48	37 12	52669	23	47331	55275	26	44725	02606	3	97394	21
40	9 22 40	2 37 20	9. 52705	24	10. 47295	9. 55315	27	10. 44685	10. 02610	3	9. 97390	20
41	22 32	37 28	52740	24	47260	55355	27	44645	02615	3	97385	19
42	22 24	37 36	52775	25	47225	55395	28	44605	02619	3	97381	18
43	22 16	37 44	52811	26	47189	55434	29	44566	02624	3	97376	17
44	22 8	37 52	52846	26	47154	55474	29	44526	02628	3	97372	16
45	9 22 0	2 38 0	9. 52881	27	10. 47119	9. 55514	30	10. 44486	10. 02633	3	9. 97367	15
46	21 52	38 8	52916	27	47084	55554	31	44446	02637	3	97363	14
47	21 44	38 16	52951	28	47049	55593	31	44407	02642	3	97358	13
48	21 36	38 24	52986	29	47014	55633	32	44367	02647	4	97353	12
49	21 28	38 32	53021	29	46979	55673	33	44327	02651	4	97349	11
50	9 21 20	2 38 40	9. 53056	30	10. 46944	9. 55712	33	10. 44288	10. 02656	4	9. 97344	10
51	21 12	38 48	53092	30	46908	55752	34	44248	02660	4	97340	9
52	21 4	38 56	53126	31	46874	55791	35	44209	02665	4	97335	8
53	20 56	39 4	53161	32	46839	55831	35	44169	02669	4	97331	7
54	20 48	39 12	53196	32	46804	55870	36	44130	02674	4	97326	6
55	9 20 40	2 39 20	9. 53231	33	10. 46769	9. 55910	37	10. 44090	10. 02678	4	9. 97322	5
56	20 32	39 28	53266	33	46734	55949	37	44051	02683	4	97317	4
57	20 24	39 36	53301	34	46699	55989	38	44011	02688	4	97312	3
58	20 16	39 44	53336	34	46664	56028	39	43972	02692	4	97308	2
59	20 8	39 52	53370	35	46630	56067	39	43933	02697	4	97303	1
60	20 0	40 0	53405	36	46595	56107	40	43893	02701	4	97299	0
M.	Hour P. M.	Hour A. M.	Cosine.	Diff.	Secant.	Cotangent.	Diff.	Tangent.	Cosecant.	Diff.	Sine.	M.

109° 70°

SINES, TANGENTS, AND SECANTS.

20°												130°
M.	Hour A. M.	Hour P. M.	Sine.	Diff.	Cosecant.	Tangent.	Diff.	Cotangent.	Secant	Diff.	Cosine.	M.
0	9 20 0	2 40 0	9. 53405	0	10. 46595	9. 56107	0	10. 43893	10. 02701	0	9. 97299	60
1	19 52	40 8	53440	1	46560	56146	1	43854	02706	0	97294	59
2	19 44	40 16	53475	1	46525	56185	1	43815	02711	0	97289	58
3	19 36	40 24	53509	2	46491	56224	2	43776	02715	0	97285	57
4	19 28	40 32	53544	2	46456	56264	3	43736	02720	0	97280	56
5	9 19 20	2 40 40	9. 53578	3	10. 46422	9. 56303	3	10. 43697	10. 02724	0	9. 97276	55
6	19 12	40 48	53613	3	46387	56342	4	43658	02729	0	97271	54
7	19 4	40 56	53647	4	46353	56381	4	43619	02734	1	97266	53
8	18 56	41 4	53682	5	46318	56420	5	43580	02738	1	97262	52
9	18 48	41 12	53716	5	46284	56459	6	43541	02743	1	97257	51
10	9 18 40	2 41 20	9. 53751	6	10. 46249	9. 56498	6	10. 43502	10. 02748	1	9. 97252	50
11	18 32	41 28	53785	6	46215	56537	7	43463	02752	1	97248	49
12	18 24	41 36	53819	7	46181	56576	8	43424	02757	1	97243	48
13	18 16	41 44	53854	7	46146	56615	8	43385	02762	1	97238	47
14	18 8	41 52	53888	8	46112	56654	9	43346	02766	1	97234	46
15	9 18 0	2 42 0	9. 53922	8	10. 46078	9. 56693	10	10. 43307	10. 02771	1	9. 97229	45
16	17 52	42 8	53957	9	46043	56732	10	43268	02776	1	97224	44
17	17 44	42 16	53991	10	46009	56771	11	43229	02780	1	97220	43
18	17 36	42 24	54025	10	45975	56810	12	43190	02785	1	97215	42
19	17 28	42 32	54059	11	45941	56849	12	43151	02790	1	97210	41
20	9 17 20	2 42 40	9. 54093	11	10. 45907	9. 56887	13	10. 43113	10. 02794	2	9. 97206	40
21	17 12	42 48	54127	12	45873	56926	13	43074	02799	2	97201	39
22	17 4	42 56	54161	12	45839	56965	14	43035	02804	2	97196	38
23	16 56	43 4	54195	13	45805	57004	15	42996	02808	2	97192	37
24	16 48	43 12	54229	14	45771	57042	15	42958	02813	2	97187	36
25	9 16 40	2 43 20	9. 54263	14	10. 45737	9. 57081	16	10. 42919	10. 02818	2	9. 97182	35
26	16 32	43 28	54297	15	45703	57120	17	42880	02822	2	97178	34
27	16 24	43 36	54331	15	45669	57158	17	42842	02827	2	97173	33
28	16 16	43 44	54365	16	45635	57197	18	42803	02832	2	97168	32
29	16 8	43 52	54399	16	45601	57235	19	42765	02837	2	97163	31
30	9 16 0	2 44 0	9. 54433	17	10. 45567	9. 57274	19	10. 42726	10. 02841	2	9. 97159	30
31	15 52	44 8	54466	17	45534	57312	20	42688	02846	2	97154	29
32	15 44	44 16	54500	18	45500	57351	21	42649	02851	3	97149	28
33	15 36	44 24	54534	19	45466	57389	21	42611	02855	3	97145	27
34	15 28	44 32	54567	19	45433	57428	22	42572	02860	3	97140	26
35	9 15 20	2 44 40	9. 54601	20	10. 45399	9. 57466	22	10. 42534	10. 02865	3	9. 97135	25
36	15 12	44 48	54635	20	45365	57504	23	42496	02870	3	97130	24
37	15 4	44 56	54668	21	45332	57543	24	42457	02874	3	97126	23
38	14 56	45 4	54702	21	45298	57581	24	42419	02879	3	97121	22
39	14 48	45 12	54735	22	45265	57619	25	42381	02884	3	97116	21
40	9 14 40	2 45 20	9. 54769	23	10. 45231	9. 57658	26	10. 42342	10. 02889	3	9. 97111	20
41	14 32	45 28	54802	23	45198	57696	26	42304	02893	3	97107	19
42	14 24	45 36	54836	24	45164	57734	27	42266	02898	3	97102	18
43	14 16	45 44	54869	24	45131	57772	28	42228	02903	3	97097	17
44	14 8	45 52	54903	25	45097	57810	28	42190	02908	3	97092	16
45	9 14 0	2 46 0	9. 54936	25	10. 45064	9. 57849	29	10. 42151	10. 02913	4	9. 97087	15
46	13 52	46 8	54969	26	45031	57887	30	42113	02917	4	97083	14
47	13 44	46 16	55003	26	44997	57925	30	42075	02922	4	97078	13
48	13 36	46 24	55036	27	44964	57963	31	42037	02927	4	97073	12
49.	13 28	46 32	55069	28	44931	58001	31	41999	02932	4	97068	11
50	9 13 20	2 46 40	9. 55102	28	10. 44898	9. 58039	32	10. 41961	10. 02937	4	9. 97063	10
51	13 12	46 48	55136	29	44864	58077	33	41923	02941	4	97059	9
52	13 4	46 56	55169	29	44831	58115	33	41885	02946	4	97054	8
53	12 56	47 4	55202	30	44798	58153	34	41847	02951	4	97049	7
54	12 48	47 12	55235	30	44765	58191	35	41809	02956	4	97044	6
55	9 12 40	2 47 20	9. 55268	31	10. 44732	9. 58229	35	10. 41771	10. 02961	4	9. 97039	5
56	12 32	47 28	55301	32	44699	58267	36	41733	02965	4	97035	4
57	12 24	47 36	55334	32	44666	58304	37	41696	02970	4	97030	3
58	12 16	47 44	55367	33	44633	58342	37	41658	02975	5	97025	2
59	12 8	47 52	55400	33	44600	58380	38	41620	02980	5	97020	1
60	12 0	48 0	55433	34	44567	58418	39	41582	02985	5	97015	0
M.	Hour P. M.	Hour A. M.	Cosine.	Diff.	Secant.	Cotangent.	Diff.	Tangent.	Cosecant.	Diff.	Sine.	M.
110°												60°

SINES, TANGENTS, AND SECANTS.

21° 158°

M.	Hour A. M.	Hour P. M.	Sine.	Diff.	Cosecant.	Tangent.	Diff.	Cotangent.	Secant.	Diff.	Cosine.	M.
0	9 12 0	2 48 0	9. 55433	0	10. 44567	9. 58418	0	10. 41582	10. 02985	0	9. 97015	60
1	11 52	48 8	55466	1	44534	58455	1	41545	02990	0	97010	59
2	11 44	48 16	55499	1	44501	58493	1	41507	02995	0	97005	58
3	11 36	48 24	55532	2	44468	58531	2	41469	02999	0	97001	57
4	11 28	48 32	55564	2	44436	58569	2	41431	03004	0	96996	56
5	9 11 20	2 48 40	9. 55597	3	10. 44403	9. 58606	3	10. 41394	10. 03009	0	9. 96991	55
6	11 12	48 48	55630	3	44370	58644	4	41356	03014	0	96986	54
7	11 4	48 56	55663	4	44337	58681	4	41319	03019	1	96981	53
8	10 56	49 4	55695	4	44305	58719	5	41281	03024	1	96976	52
9	10 48	49 12	55728	5	44272	58757	6	41243	03029	1	96971	51
10	9 10 40	2 49 20	9. 55761	5	10. 44239	9. 58794	6	10. 41206	10. 03034	1	9. 96966	50
11	10 32	49 28	55793	6	44207	58832	7	41168	03038	1	96962	49
12	10 24	49 36	55826	6	44174	58869	7	41131	03043	1	96957	48
13	10 16	49 44	55858	7	44142	58907	8	41093	03048	1	96952	47
14	10 8	49 52	55891	7	44109	58944	9	41056	03053	1	96947	46
15	9 10 0	2 50 0	9. 55923	8	10. 44077	9. 58981	9	10. 41019	10. 03058	1	9. 96942	45
16	9 52	50 8	55956	9	44044	59019	10	40981	03063	1	96937	44
17	9 44	50 16	55988	9	44012	59056	10	40944	03068	1	96932	43
18	9 36	50 24	56021	10	43979	59094	11	40906	03073	1	96927	42
19	9 28	50 32	56053	10	43947	59131	12	40869	03078	2	96922	41
20	9 9 20	2 50 40	9. 56085	11	10. 43915	9. 59168	12	10. 40832	10. 03083	2	9. 96917	40
21	9 12	50 48	56118	11	41882	59205	13	40795	03088	2	96912	39
22	9 4	50 56	56150	12	43850	59243	14	40757	03093	2	96907	38
23	8 56	51 4	56182	12	43818	59280	14	40720	03097	2	96903	37
24	8 48	51 12	56215	13	43785	59317	15	40683	03102	2	96898	36
25	9 8 40	2 51 20	9. 56247	13	10. 43753	9. 59354	15	10. 40646	10. 03107	2	9. 96893	35
26	8 32	51 28	56279	14	43721	59391	16	40609	03112	2	96888	34
27	8 24	51 36	56311	14	43689	59429	17	40571	03117	2	96883	33
28	8 16	51 44	56343	15	43657	59466	17	40534	03122	2	96878	32
29	8 8	51 52	56375	16	43625	59503	18	40497	03127	2	96873	31
30	9 8 0	2 52 0	9. 56408	16	10. 43592	9. 59540	19	10. 40460	10. 03132	2	9. 96868	30
31	7 52	52 8	56440	17	43560	59577	19	40423	03137	3	96863	29
32	7 44	52 16	56472	17	43528	59614	20	40386	03142	3	96858	28
33	7 36	52 24	56504	18	43496	59651	20	40349	03147	3	96853	27
34	7 28	52 32	56536	18	43464	59688	21	40312	03152	3	96848	26
35	9 7 20.	2 52 40	9. 56568	19	10. 43432	9. 59725	22	10. 40275	10. 03157	3	9. 96843	25
36	7 12	52 48	56599	19	43401	59762	22	40238	03162	3	96838	24
37	7 4	52 56	56631	20	43369	59799	23	40201	03167	3	96833	23
38	6 56	53 4	56663	20	43337	59835	23	40165	03172	3	96828	22
39	6 48	53 12	56695	21	43305	59872	24	40128	03177	3	96823	21
40	9 6 40	2 53 20	9. 56727	21	10. 43273	9. 59909	25	10. 40091	10. 03182	3	9. 96818	20
41	6 32	53 28	56759	22	43241	59946	25	40054	03187	3	96813	19
42	6 24	53 36	56790	22	43210	59983	26	40017	03192	3	96808	18
43	6 16	53 44	56822	23	43178	60019	27	39981	03197	4	96803	17
44	6 8	53 52	56854	24	43146	60056	27	39944	03202	4	96798	16
45	9 6 0	2 54 0	9. 56886	24	10. 43114	9. 60093	28	10. 39907	10. 03207	4	9. 96793	15
46	5 52	54 8	56917	25	43083	60130	28	39870	03212	4	96788	14
47	5 44	54 16	56949	25	43051	60166	29	39834	03217	4	96783	13
48	5 36	54 24	56980	26	43020	60203	30	39797	03222	4	96778	12
49	5 28	54 32	57012	26	42988	60240	30	39760	03228	4	96772	11
50	9 5 20	2 54 40	9. 57044	27	10. 42956	9. 60276	31	10. 39724	10. 03233	4	9. 96767	10
51	5 12	54 48	57075	27	42925	60313	31	39687	03238	4	96762	9
52	5 4	54 56	57107	28	42893	60349	32	39651	03243	4	96757	8
53	4 56	55 4	57138	28	42862	60386	33	39614	03248	4	96752	7
54	4 48	55 12	57169	29	42831	60422	33	39578	03253	4	96747	6
55	9 4 40	2 55 20	9. 57201	29	10. 42799	9. 60459	34	10. 39541	10. 03258	5	9. 96742	5
56	4 32	55 28	57232	30	42768	60495	35	39505	03263	5	96737	4
57	4 24	55 36	57264	30	42736	60532	35	39468	03268	5	96732	3
58	4 16	55 44	57295	31	42705	60568	36	39432	03273	5	96727	2
59	4 8	55 52	57326	32	42674	60605	36	39395	03278	5	96722	1
60	4 0	56 0	57358	32	42642	60641	37	39359	03283	5	96717	0
M.	Hour P. M.	Hour A. M.	Cosine.	Diff.	Secant.	Cotangent.	Diff.	Tangent.	Cosecant.	Diff.	Sine.	M.

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SINES, TANGENTS, AND SECANTS.

22°

157°

M.	Hour A. M.	Hour P. M.	Sine.	Diff.	Cosecant.	Tangent.	Diff.	Cotangent.	Secant.	Diff.	Cosine.	M.
0	9 4 0	2 56 0	9. 57358	0	10. 42642	9. 60641	0	10. 39359	10. 03283	0	9. 96717	60
1	3 52	56 8	57389	1	42611	60677	1	39323	03289	0	96711	59
2	3 44	56 16	57420	1	42580	60714	1	39286	03294	0	96706	58
3	3 36	56 24	57451	2	42549	60750	2	39250	03299	0	96701	57
4	3 28	56 32	57482	2	42518	60786	2	39214	03304	0	96696	56
5	9 3 20	2 56 40	9. 57514	3	10. 42486	9. 60823	3	10. 39177	10. 03309	0	9. 96691	55
6	3 12	56 48	57545	3	42455	60859	4	39141	03314	1	96686	54
7	3 4	56 56	57576	4	42424	60895	4	39105	03319	1	96681	53
8	2 56	57 4	57607	4	42393	60931	5	39069	03324	1	96676	52
9	2 48	57 12	57638	5	42362	60967	5	39033	03330	1	96670	51
10	9 2 40	2 57 20	9. 57669	5	10. 42331	9. 61004	6	10. 38996	10. 03335	1	9. 96665	50
11	2 32	57 28	57700	6	42300	61040	7	38960	03340	1	96660	49
12	2 24	57 36	57731	6	42269	61076	7	38924	03345	1	96655	48
13	2 16	57 44	57762	7	42238	61112	8	38888	03350	1	96650	47
14	2 8	57 52	57793	7	42207	61148	8	38852	03355	1	96645	46
15	9 2 0	2 58 0	9. 57824	8	10. 42176	9. 61184	9	10. 38816	10. 03360	1	9. 96640	45
16	1 52	58 8	57855	8	42145	61220	10	38780	03366	1	96634	44
17	1 44	58 16	57885	9	42115	61256	10	38744	03371	1	96629	43
18	1 36	58 24	57916	9	42084	61292	11	38708	03376	2	96624	42
19	1 28	58 32	57947	10	42053	61328	11	38672	03381	2	96619	41
20	9 1 20	2 58 40	9. 57978	10	10. 42022	9. 61364	12	10. 38636	10. 03386	2	9. 96614	40
21	1 12	58 48	58008	11	41992	61400	13	38600	03392	2	96608	39
22	1 4	58 56	58039	11	41961	61436	13	38564	03397	2	96603	38
23	0 56	59 4	58070	12	41930	61472	14	38528	03402	2	96598	37
24	0 48	59 12	58101	12	41899	61508	14	38492	03407	2	96593	36
25	9 0 40	2 59 20	9. 58131	13	10. 41869	9. 61544	15	10. 38456	10. 03412	2	9. 96588	35
26	0 32	59 28	58162	13	41838	61579	15	38421	03418	2	96582	34
27	0 24	59 36	58192	14	41808	61615	16	38385	03423	2	96577	33
28	0 16	59 44	58223	14	41777	61651	17	38349	03428	2	96572	32
29	0 8	59 52	58253	15	41747	61687	17	38313	03433	3	96567	31
30	9 0 0	3 0 0	9. 58284	15	10. 41716	9. 61722	18	10. 38278	10. 03438	3	9. 96562	30
31	8 59 52	0 8	58314	16	41686	61758	18	38242	03444	3	96556	29
32	59 44	0 16	58345	16	41655	61794	19	38206	03449	3	96551	28
33	59 36	0 24	58375	17	41625	61830	20	38170	03454	3	96546	27
34	59 28	0 32	58406	17	41594	61865	20	38135	03459	3	96541	26
35	8 59 20	3 0 40	9. 58436	18	10. 41564	9. 61901	21	10. 38099	10. 03465	3	9. 96535	25
36	59 12	0 48	58467	18	41533	61936	21	38063	03470	3	96530	24
37	59 4	0 56	58497	19	41503	61972	22	38028	03475	3	96525	23
38	58 56	1 4	58527	19	41473	62008	23	37992	03480	3	96520	22
39	58 48	1 12	58557	20	41443	62043	23	37957	03486	3	96514	21
40	8 58 40	3 1 20	9. 58588	20	10. 41412	9. 62079	24	10. 37921	10. 03491	3	9. 96509	20
41	58 32	1 28	58618	21	41382	62114	24	37886	03496	4	96504	19
42	58 24	1 36	58648	21	41352	62150	25	37850	03502	4	96498	18
43	58 16	1 44	58678	22	41322	62185	26	37815	03507	4	96493	17
44	58 8	1 52	58709	22	41291	62221	26	37779	03512	4	96488	16
45	8 58 0	3 2 0	9. 58739	23	10. 41261	9. 62256	27	10. 37744	10. 03517	4	9. 96483	15
46	57 52	2 8	58769	23	41231	62292	27	37708	03523	4	96477	14
47	57 44	2 16	58799	24	41201	62327	28	37673	03528	4	96472	13
48	57 36	2 24	58829	24	41171	62362	29	37638	03533	4	96467	12
49	57 28	2 32	58859	25	41141	62398	29	37602	03539	4	96461	11
50	8 57 20	3 2 40	9. 58889	25	10. 41111	9. 62433	30	10. 37567	10. 03544	4	9. 96456	10
51	57 12	2 48	58919	26	41081	62468	30	37532	03549	4	96451	9
52	57 4	2 56	58949	26	41051	62504	31	37496	03555	5	96445	8
53	56 56	3 4	58979	27	41021	62539	32	37461	03560	5	96440	7
54	56 48	3 12	59009	27	40991	62574	32	37426	03565	5	96435	6
55	8 56 40	3 3 20	9. 59039	28	10. 40961	9. 62609	33	10. 37391	10. 03571	5	9. 96429	5
56	56 32	3 28	59069	28	40931	62645	33	37355	03576	5	96424	4
57	56 24	3 36	59098	29	40902	62680	34	37320	03581	5	96419	3
58	56 16	3 44	59128	29	40872	62715	35	37285	03587	5	96413	2
59	56 8	3 52	59158	30	40842	62750	35	37250	03592	5	96408	1
60	56 0	4 0	59188	31	40812	62785	36	37215	03597	5	96403	0
M.	Hour P. M.	Hour A. M.	Cosine.	Diff.	Secant.	Cotangent.	Diff.	Tangent.	Cosecant.	Diff.	Sine.	M.

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SINES, TANGENTS, AND SECANTS.

23°												156°
N.	Hour A. M.	Hour P. M.	Sine.	Diff.	Cosecant.	Tangent.	Diff.	Cotangent.	Secant.	Diff.	Cosine.	M.
0	8 56 0	3 4 0	9. 59188	0	10. 40812	9. 62785	0	10. 37215	10. 03597	0	9. 96403	60
1	55 52	4 8	59218	0	40782	62820	1	37180	03603	0	96397	59
2	55 44	4 16	59247	1	40753	62855	1	37145	03608	0	96392	58
3	55 36	4 24	59277	1	40723	62890	2	37110	03613	0	96387	57
4	55 28	4 32	59307	2	40693	62926	2	37074	03619	0	96381	56
5	8 55 20	3 4 40	9. 59336	2	10. 40664	9. 62961	3	10. 37039	10. 03624	0	9. 96376	55
6	55 12	4 48	59366	3	40634	62996	3	37004	03630	1	96370	54
7	55 4	4 56	59396	3	40604	63031	4	36969	03635	1	96365	53
8	54 56	5 4	59425	4	40575	63066	5	36934	03640	1	96360	52
9	54 48	5 12	59455	4	40545	63101	5	36899	03646	1	96354	51
10	8 54 40	3 5 20	9. 59484	5	10. 40516	9. 63135	6	10. 36865	10. 03651	1	9. 96349	50
11	54 32	5 28	59514	5	40486	63170	6	36830	03657	1	96343	49
12	54 24	5 36	59543	6	40457	63205	7	36795	03662	1	96338	48
13	54 16	5 44	59573	6	40427	63240	7	36760	03667	1	96333	47
14	54 8	5 52	59602	7	40398	63275	8	36725	03673	1	96327	46
15	8 54 0	3 6 0	9. 59632	7	10. 40368	9. 63310	9	10. 36690	10. 03678	1	9. 96322	45
16	53 52	6 8	59661	8	40339	63345	9	36655	03684	1	96316	44
17	53 44	6 16	59690	8	40310	63379	10	36621	03689	2	96311	43
18	53 36	6 24	59720	9	40280	63414	10	36586	03695	2	96305	42
19	53 28	6 32	59749	9	40251	63449	11	36551	03700	2	96300	41
20	8 53 20	3 6 40	9. 59778	10	10. 40222	9. 63484	12	10. 36516	10. 03706	2	9. 96294	40
21	53 12	6 48	59808	10	40192	63519	12	36481	03711	2	96289	39
22	53 4	6 56	59837	11	40163	63553	13	36447	03716	2	96284	38
23	52 56	7 4	59866	11	40134	63588	13	36412	03722	2	96278	37
24	52 48	7 12	59895	12	40105	63623	14	36377	03727	2	96273	36
25	8 52 40	3 7 20	9. 59924	12	10. 40076	9. 63657	14	10. 36343	10. 03733	2	9. 96267	35
26	52 32	7 28	59954	13	40046	63692	15	36308	03738	2	96262	34
27	52 24	7 36	59983	13	40017	63726	16	36274	03744	2	96256	33
28	52 16	7 44	60012	14	39988	63761	16	36239	03749	3	96251	32
29	52 8	7 52	60041	14	39959	63796	17	36204	03755	3	96245	31
30	8 52 0	3 8 0	9. 60070	15	10. 39930	9. 63830	17	10. 36170	10. 03760	3	9. 96240	30
31	51 52	8 8	60099	15	39901	63865	18	36135	03766	3	96234	29
32	51 44	8 16	60128	15	39872	63899	18	36101	03771	3	96229	28
33	51 36	8 24	60157	16	39843	63934	19	36066	03777	3	96223	27
34	51 28	8 32	60186	16	39814	63968	20	36032	03782	3	96218	26
35	8 51 20	3 8 40	9. 60215	17	10. 39785	9. 64003	20	10. 35997	10. 03788	3	9. 96212	25
36	51 12	8 48	60244	17	39756	64037	21	35963	03793	3	96207	24
37	51 4	8 56	60273	18	39727	64072	21	35928	03799	3	96201	23
38	50 56	9 4	60302	18	39698	64106	22	35894	03804	3	96196	22
39	50 48	9 12	60331	19	39669	64140	22	35860	03810	4	96190	21
40	8 50 40	3 9 20	9. 60359	19	10. 39641	9. 64175	23	10. 35825	10. 03815	4	9. 96185	20
41	50 32	9 28	60388	20	39612	64209	24	35791	03821	4	96179	19
42	50 24	9 36	60417	20	39583	64243	24	35757	03826	4	96174	18
43	50 16	9 44	60446	21	39554	64278	25	35722	03832	4	96168	17
44	50 8	9 52	60474	21	39526	64312	25	35688	03838	4	96162	16
45	8 50 0	3 10 0	9. 60503	22	10. 39497	9. 64346	26	10. 35654	10. 03843	4	9. 96157	15
46	49 52	10 8	60532	22	39468	64381	26	35619	03849	4	96151	14
47	49 44	10 16	60561	23	39439	64415	27	35585	03854	4	96146	13
48	49 36	10 24	60589	23	39411	64449	28	35551	03860	4	96140	12
49	49 28	10 32	60618	24	39382	64483	28	35517	03865	4	96135	11
50	8 49 20	3 10 40	9. 60646	24	10. 39354	9. 64517	29	10. 35483	10. 03871	5	9. 96129	10
51	49 12	10 48	60675	25	39325	64552	29	35448	03877	5	96123	9
52	49 4	10 56	60704	25	39296	64586	30	35414	03882	5	96118	8
53	48 56	11 4	60732	26	39268	64620	31	35380	03888	5	96112	7
54	48 48	11 12	60761	26	39239	64654	31	35346	03893	5	96107	6
55	8 48 40	3 11 20	9. 60789	27	10. 39211	9. 64688	32	10. 35312	10. 03899	5	9. 96101	5
56	48 32	11 28	60818	27	39182	64722	32	35278	03905	5	96095	4
57	48 24	11 36	60846	28	39154	64756	33	35244	03910	5	96090	3
58	48 16	11 44	60875	28	39125	64790	33	35210	03916	5	96084	2
59	48 8	11 52	60903	29	39097	64824	34	35176	03921	5	96079	1
60	48 0	12 0	60931	29	39069	64858	35	35142	03927	6	96073	0
M.	Hour P. M.	Hour A. M.	Cosine.	Diff.	Secant.	Cotangent.	Diff.	Tangent.	Cosecant.	Diff.	Sine.	M.
113°												66°

SINES, TANGENTS, AND SECANTS.

21°												155°
M.	Hour A. M.	Hour P. M.	Sine.	Diff.	Cosecant.	Tangent.	Diff.	Cotangent.	Secant.	Diff.	Cosine.	M.
0	8 48 0	3 12 0	9. 60931	0	10. 39069	9. 64858	0	10. 35142	10. 03927	0	9. 96073	60
1	47 52	12 8	60960	0	39040	64892	1	35108	03933	0	96067	59
2	47 44	12 16	60988	1	39012	64926	1	35074	03938	0	96062	58
3	47 36	12 24	61016	1	38984	64960	2	35040	03944	0	96056	57
4	47 28	12 32	61045	2	38955	64994	2	35006	03950	0	96050	56
5	8 47 20	3 12 40	9. 61073	2	10. 38927	9. 65028	3	10. 34972	10. 03955	0	9. 96045	55
6	47 12	12 48	61101	3	38899	65062	3	34938	03961	1	96039	54
7	47 4	12 56	61129	3	38871	65096	4	34904	03966	1	96034	53
8	46 56	13 4	61158	4	38842	65130	4	34870	03972	1	96028	52
9	46 48	13 12	61186	4	38814	65164	5	34836	03978	1	96022	51
10	8 46 40	3 13 20	9. 61214	5	10. 38786	9. 65197	6	10. 34803	10. 03983	1	9. 96017	50
11	46 32	13 28	61242	5	38758	65231	6	34769	03989	1	96011	49
12	46 24	13 36	61270	6	38730	65265	7	34735	03995	1	96005	48
13	46 16	13 44	61298	6	38702	65299	7	34701	04000	1	96000	47
14	46 8	13 52	61326	6	38674	65333	8	34667	04006	1	95994	46
15	8 46 0	3 14 0	9. 61354	7	10. 38646	9. 65366	8	10. 34634	10. 04012	1	9. 95988	45
16	45 52	14 8	61382	7	38618	65400	9	34600	04018	2	95982	44
17	45 44	14 16	61411	8	38589	65434	9	34566	04023	2	95977	43
18	45 36	14 24	61438	8	38562	65467	10	34533	04029	2	95971	42
19	45 28	14 32	61466	9	38534	65501	11	34499	04035	2	95965	41
20	8 45 20	3 14 40	9. 61494	9	10. 38506	9. 65535	11	10. 34465	10. 04040	2	9. 95960	40
21	45 12	14 48	61522	10	38478	65568	12	34432	04046	2	95954	39
22	45 4	14 56	61550	10	38450	65602	12	34398	04052	2	95948	38
23	44 56	15 4	61578	11	38422	65636	13	34364	04058	2	95942	37
24	44 48	15 12	61606	11	38394	65669	13	34331	04063	2	95937	36
25	8 44 40	3 15 20	9. 61634	12	10. 38366	9. 65703	14	10. 34297	10. 04069	2	9. 95931	35
26	44 32	15 28	61662	12	38338	65736	15	34264	04075	2	95925	34
27	44 24	15 36	61689	12	38311	65770	15	34230	04080	3	95920	33
28	44 16	15 44	61717	13	38283	65803	16	34197	04086	3	95914	32
29	44 8	15 52	61745	13	38255	65837	16	34163	04092	3	95908	31
30	8 44 0	3 16 0	9. 61773	14	10. 38227	9. 65870	17	10. 34130	10. 04098	3	9. 95902	30
31	43 52	16 8	61800	14	38200	65904	17	34096	04103	3	95897	29
32	43 44	16 16	61828	15	38172	65937	18	34063	04109	3	95891	28
33	43 36	16 24	61856	15	38144	65971	18	34029	04115	3	95885	27
34	43 28	16 32	61883	16	38117	66004	19	33996	04121	3	95879	26
35	8 43 20	3 16 40	9. 61911	16	10. 38089	9. 66038	20	10. 33962	10. 04127	3	9. 95873	25
36	43 12	16 48	61939	17	38061	66071	20	33929	04132	3	95868	24
37	43 4	16 56	61966	17	38034	66104	21	33896	04138	4	95862	23
38	42 56	17 4	61994	18	38006	66138	21	33862	04144	4	95856	22
39	42 48	17 12	62021	18	37979	66171	22	33829	04150	4	95850	21
40	8 42 40	3 17 20	9. 62049	18	10. 37951	9. 66204	22	10. 33796	10. 04156	4	9. 95844	20
41	42 32	17 28	62076	19	37924	66238	23	33762	04161	4	95839	19
42	42 24	17 36	62104	19	37896	66271	23	33729	04167	4	95833	18
43	42 16	17 44	62131	20	37869	66304	24	33696	04173	4	95827	17
44	42 8	17 52	62159	20	37841	66337	25	33663	04179	4	95821	16
45	8 42 0	3 18 0	9. 62186	21	10. 37814	9. 66371	25	10. 33629	10. 04185	4	9. 95815	15
46	41 52	18 8	62214	21	37786	66404	26	33596	04190	4	95810	14
47	41 44	18 16	62241	22	37759	66437	26	33563	04196	5	95804	13
48	41 36	18 24	62268	22	37732	66470	27	33530	04202	5	95798	12
49	41 28	18 32	62296	23	37704	66503	27	33497	04208	5	95792	11
50	8 41 20	3 18 40	9. 62323	23	10. 37677	9. 66537	28	10. 33463	10. 04214	5	9. 95786	10
51	41 12	18 48	62350	24	37650	66570	28	33430	04220	5	95780	9
52	41 4	18 56	62377	24	37623	66603	29	33397	04225	5	95775	8
53	40 56	19 4	62405	24	37595	66636	30	33364	04231	5	95769	7
54	40 48	19 12	62432	25	37568	66669	30	33331	04237	5	95763	6
55	8 40 40	3 19 2	9. 62459	25	10. 37541	9. 66702	31	10. 33298	10. 04243	5	9. 95757	5
56	40 32	19 28	62486	26	37514	66735	31	33265	04249	5	95751	4
57	40 24	19 36	62513	26	37487	66768	32	33232	04255	5	95745	3
58	40 16	19 44	62541	27	37459	66801	32	33199	04261	6	95739	2
59	40 8	19 52	62568	27	37432	66834	33	33166	04267	6	95733	1
60	40 0	20 0	62595	28	37405	66867	33	33133	04272	6	95728	0
M.	Hour P. M.	Hour A. M.	Cosine.	Diff.	Secant.	Cotangent.	Diff.	Tangent.	Cosecant.	Diff.	Sine.	M.
111°												65°

SINES, TANGENTS, AND SECANTS.

25°												154°
M.	Hour A. M.	Hour P. M.	Sine.	Diff.	Cosecant.	Tangent.	Diff.	Cotangent.	Secant.	Diff.	Cosine.	M.
0	8 40 0	3 20 0	9. 62595	0	10. 37405	9. 66867	0	10. 33133	10. 04272	0	9. 95728	60
1	39 52	20 8	62622	0	37378	66900	1	33100	04278	0	95722	59
2	39 44	20 16	62649	1	37351	66933	1	33067	04284	0	95716	58
3	39 36	20 24	62676	1	37324	66966	2	33034	04290	0	95710	57
4	39 28	20 32	62703	2	37297	66999	2	33001	04296	0	95704	56
5	8 39 20	3 20 40	9. 62730	2	10. 37270	9. 67032	3	10. 32968	10. 04302	1	9. 95698	55
6	39 12	20 48	62757	3	37243	67065	3	32935	04308	1	95692	54
7	39 4	20 56	62784	3	37216	67098	4	32902	04314	1	95686	53
8	38 56	21 4	62811	4	37189	67131	4	32869	04320	1	95680	52
9	38 48	21 12	62838	4	37162	67163	5	32837	04326	1	95674	51
10	8 38 40	3 21 20	9. 62865	4	10. 37135	9. 67196	5	10. 32804	10. 04332	1	9. 95668	50
11	38 32	21 28	62892	5	37108	67229	6	32771	04337	1	95663	49
12	38 24	21 36	62918	5	37082	67262	7	32738	04343	1	95657	48
13	38 16	21 44	62945	6	37055	67295	7	32705	04349	1	95651	47
14	38 8	21 52	62972	6	37028	67327	8	32673	04355	1	95645	46
15	8 38 0	3 22 0	9. 62999	7	10. 37001	9. 67360	8	10. 32640	10. 04361	2	9. 95639	45
16	37 52	22 8	63026	7	36974	67393	9	32607	04367	2	95633	44
17	37 44	22 16	63052	8	36948	67426	9	32574	04373	2	95627	43
18	37 36	22 24	63079	8	36921	67458	10	32542	04379	2	95621	42
19	37 28	22 32	63106	8	36894	67491	10	32509	04385	2	95615	41
20	8 37 20	3 22 40	9. 63133	9	10. 36867	9. 67524	11	10. 32476	10. 04391	2	9. 95609	40
21	37 12	22 48	63159	9	36841	67556	11	32444	04397	2	95603	39
22	37 4	22 56	63186	10	36814	67589	12	32411	04403	2	95597	38
23	36 56	23 4	63213	10	36787	67622	12	32378	04409	2	95591	37
24	36 48	23 12	63239	11	36761	67654	13	32346	04415	2	95585	36
25	8 36 40	3 23 20	9. 63266	11	10. 36734	9. 67687	14	10. 32313	10. 04421	3	9. 95579	35
26	36 32	23 28	63292	11	36708	67719	14	32281	04427	3	95573	34
27	36 24	23 36	63319	12	36681	67752	15	32248	04433	3	95567	33
28	36 16	23 44	63345	12	36655	67785	15	32215	04439	3	95561	32
29	36 8	23 52	63372	13	36628	67817	16	32183	04445	3	95555	31
30	8 36 0	3 24 0	9. 63398	13	10. 36602	9. 67850	16	10. 32150	10. 04451	3	9. 95549	30
31	35 52	24 8	63425	14	36575	67882	17	32118	04457	3	95543	29
32	35 44	24 16	63451	14	36549	67915	17	32085	04463	3	95537	28
33	35 36	24 24	63478	15	36522	67947	18	32053	04469	3	95531	27
34	35 28	24 32	63504	15	36496	67980	18	32020	04475	3	95525	26
35	8 35 20	3 24 40	9. 63531	15	10. 36469	9. 68012	19	10. 31988	10. 04481	4	9. 95519	25
36	35 12	24 48	63557	16	36443	68044	20	31956	04487	4	95513	24
37	35 4	24 56	63583	16	36417	68077	20	31923	04493	4	95507	23
38	34 56	25 4	63610	17	36390	68109	21	31891	04500	4	95500	22
39	34 48	25 12	63636	17	36364	68142	21	31858	04506	4	95494	21
40	8 34 40	3 25 20	9. 63662	18	10. 36338	9. 68174	22	10. 31826	10. 04512	4	9. 95488	20
41	34 32	25 28	63689	18	36311	68206	22	31794	04518	4	95482	19
42	34 24	25 36	63715	19	36285	68239	23	31761	04524	4	95476	18
43	34 16	25 44	63741	19	36259	68271	23	31729	04530	4	95470	17
44	34 8	25 52	63767	19	36233	68303	24	31697	04536	4	95464	16
45	8 34 0	3 26 0	9. 63794	20	10. 36206	9. 68336	24	10. 31664	10. 04542	5	9. 95458	15
46	33 52	26 8	63820	20	36180	68368	25	31632	04548	5	95452	14
47	33 44	26 16	63846	21	36154	68400	25	31600	04554	5	95446	13
48	33 36	26 24	63872	21	36128	68432	26	31568	04560	5	95440	12
49	33 28	26 32	63898	22	36102	68465	27	31535	04566	5	95434	11
50	8 33 20	3 26 40	9. 63924	22	10. 36076	9. 68497	27	10. 31503	10. 04573	5	9. 95427	10
51	33 12	26 48	63950	23	36050	68529	28	31471	04579	5	95421	9
52	33 4	26 56	63976	23	36024	68561	28	31439	04585	5	95415	8
53	32 56	27 4	64002	23	35998	68593	29	31407	04591	5	95409	7
54	32 48	27 12	64028	24	35972	68626	29	31374	04597	5	95403	6
55	8 32 40	3 27 20	9. 64054	24	10. 35946	9. 68658	30	10. 31342	10. 04603	6	9. 95397	5
56	32 32	27 28	64080	25	35920	68690	30	31310	04609	6	95391	4
57	32 24	27 36	64106	25	35894	68722	31	31278	04616	6	95384	3
58	32 16	27 44	64132	26	35868	68754	31	31246	04622	6	95378	2
59	32 8	27 52	64158	26	35842	68786	32	31214	04628	6	95372	1
60	32 0	28 0	64184	26	35816	68818	33	31182	04634	6	95366	0
M.	Hour P. M.	Hour A. M.	Cosine.	Diff.	Secant.	Cotangent.	Diff.	Tangent.	Cosecant.	Diff.	Sine.	M.
115°												64°

SINES, TANGENTS, AND SECANTS.

26°												153°
M.	Hour A. M.	Hour P. M.	Sine.	Diff.	Cosecant.	Tangent.	Diff.	Cotangent.	Secant.	Diff.	Cosine.	M.
0	8 32 0	3 28 0	9. 64184	0	10. 35816	9. 68818	0	10. 31182	10. 04634	0	9. 95366	60
1	31 52	28 8	64210	0	35790	68850	1	31150	04640	0	95360	59
2	31 44	28 16	64236	1	35764	68882	1	31118	04646	0	95354	58
3	31 36	28 24	64262	1	35738	68914	2	31086	04652	0	95348	57
4	31 28	28 32	64288	2	35712	68946	2	31054	04659	0	95341	56
5	8 31 20	3 28 40	9. 64313	2	10. 35687	9. 68978	3	10. 31022	10. 04665	1	9. 95335	55
6	31 12	28 48	64339	3	35661	69010	3	30990	04671	1	95329	54
7	31 4	28 56	64365	3	35635	69042	4	30958	04677	1	95323	53
8	30 56	29 4	64391	3	35609	69074	4	30926	04683	1	95317	52
9	30 48	29 12	64417	4	35583	69106	5	30894	04690	1	95310	51
10	8 30 40	3 29 20	9. 64442	4	10. 35558	9. 69138	5	10. 30862	10. 04696	1	9. 95304	50
11	30 32	29 28	64468	5	35532	69170	6	30830	04702	1	95298	49
12	30 24	29 36	64494	5	35506	69202	6	30798	04708	1	95292	48
13	30 16	29 44	64519	5	35481	69234	7	30766	04714	1	95286	47
14	30 8	29 52	64545	6	35455	69266	7	30734	04721	1	95279	46
15	8 30 0	3 30 0	9. 64571	6	10. 35429	9. 69298	8	10. 30702	10. 04727	2	9. 95273	45
16	29 52	30 8	64596	7	35404	69329	8	30671	04733	2	95267	44
17	29 44	30 16	64622	7	35378	69361	9	30639	04739	2	95261	43
18	29 36	30 24	64647	8	35353	69393	9	30607	04746	2	95254	42
19	29 28	30 32	64673	8	35327	69425	10	30575	04752	2	95248	41
20	8 29 20	3 30 40	9. 64698	8	10. 35302	9. 69457	11	10. 30543	10. 04758	2	9. 95242	40
21	29 12	30 48	64724	9	35276	69488	11	30512	04764	2	95236	39
22	29 4	30 56	64749	9	35251	69520	12	30480	04771	2	95229	38
23	28 56	31 4	64775	10	35225	69552	12	30448	04777	2	95223	37
24	28 48	31 12	64800	10	35200	69584	13	30416	04783	3	95217	36
25	8 28 40	3 31 20	9. 64826	11	10. 35174	9. 69615	13	10. 30385	10. 04789	3	9. 95211	35
26	28 32	31 28	64851	11	35149	69647	14	30353	04796	3	95204	34
27	28 24	31 36	64877	11	35123	69679	14	30321	04802	3	95198	33
28	28 16	31 44	64902	12	35098	69710	15	30290	04808	3	95192	32
29	28 8	31 52	64927	12	35073	69742	15	30258	04815	3	95185	31
30	8 28 0	3 32 0	9. 64953	13	10. 35047	9. 69774	16	10. 30226	10. 04821	3	9. 95179	30
31	27 52	32 8	64978	13	35022	69805	16	30195	04827	3	95173	29
32	27 44	32 16	65003	14	34997	69837	17	30163	04833	3	95167	28
33	27 36	32 24	65029	14	34971	69868	17	30132	04840	3	95160	27
34	27 28	32 32	65054	14	34946	69900	18	30100	04846	4	95154	26
35	8 27 20	3 32 40	9. 65079	15	10. 34921	9. 69932	18	10. 30068	10. 04852	4	9. 95148	25
36	27 12	32 48	65104	15	34896	69963	19	30037	04859	4	95141	24
37	27 4	32 56	65130	16	34870	69995	20	30005	04865	4	95135	23
38	26 56	33 4	65155	16	34845	70026	20	29974	04871	4	95129	22
39	26 48	33 12	65180	16	34820	70058	21	29942	04878	4	95122	21
40	8 26 40	3 33 20	9. 65205	17	10. 34795	9. 70089	21	10. 29911	10. 04884	4	9. 95116	20
41	26 32	33 28	65230	17	34770	70121	22	29879	04890	4	95110	19
42	26 24	33 36	65255	18	34745	70152	22	29848	04897	4	95103	18
43	26 16	33 44	65281	18	34719	70184	23	29816	04903	5	95097	17
44	26 8	33 52	65306	19	34694	70215	23	29785	04910	5	95090	16
45	8 26 0	3 34 0	9. 65331	19	10. 34669	9. 70247	24	10. 29753	10. 04916	5	9. 95084	15
46	25 52	34 8	65356	19	34644	70278	24	29722	04922	5	95078	14
47	25 44	34 16	65381	20	34619	70309	25	29691	04929	5	95071	13
48	25 36	34 24	65406	20	34594	70341	25	29659	04935	5	95065	12
49	25 28	34 32	65431	21	34569	70372	26	29628	04941	5	95059	11
50	8 25 20	3 34 40	9. 65456	21	10. 34544	9. 70404	26	10. 29596	10. 04948	5	9. 95052	10
51	25 12	34 48	65481	22	34519	70435	27	29565	04954	5	95046	9
52	25 4	34 56	65506	22	34494	70466	27	29534	04961	5	95039	8
53	24 56	35 4	65531	22	34469	70498	28	29502	04967	6	95033	7
54	24 48	35 12	65556	23	34444	70529	28	29471	04973	6	95027	6
55	8 24 40	3 35 20	9. 65580	23	10. 34420	9. 70560	29	10. 29440	10. 04980	6	9. 95020	5
56	24 32	35 28	65605	24	34395	70592	30	29408	04986	6	95014	4
57	24 24	35 36	65630	24	34370	70623	30	29377	04993	6	95007	3
58	24 16	35 44	65655	25	34345	70654	31	29346	04999	6	95001	2
59	24 8	35 52	65680	25	34320	70685	31	29315	05005	6	94995	1
60	24 0	36 0	65705	25	34295	70717	32	29283	05012	6	94988	0
M.	Hour P. M.	Hour A. M.	Cosine.	Diff.	Secant.	Cotangent.	Diff.	Tangent.	Cosecant.	Diff	Sine.	M.
116°												63°

27° 153°

M.	Hour A. M.	Hour P. M.	Sine.	Diff.	Cosecant.	Tangent.	Diff.	Cotangent.	Secant.	Diff.	Cosine.	M.
0	8 24 0	3 36 0	9. 65705	0	10. 34295	9. 70717	0	10. 29283	10. 05012	0	9. 94988	60
1	23 52	36 8	65729	0	34271	70748	1	29252	05018	0	94982	59
2	23 44	36 16	65754	1	34246	70779	1	29221	05025	0	94975	58
3	23 36	36 24	65779	1	34221	70810	2	29190	05031	0	94969	57
4	23 28	36 32	65804	2	34196	70841	2	29159	05038	0	94962	56
5	8 23 20	3 36 40	9. 65828	2	10. 34172	9. 70873	3	10. 29127	10. 05044	1	9. 94956	55
6	23 12	36 48	65853	2	34147	70904	3	29096	05051	1	94949	54
7	23 4	36 56	65878	3	34122	70935	4	29065	05057	1	94943	53
8	22 56	37 4	65902	3	34098	70966	4	29034	05064	1	94936	52
9	22 48	37 12	65927	4	34073	70997	5	29003	05070	1	94930	51
10	8 22 40	3 37 20	9. 65952	4	10. 34048	9. 71028	5	10. 28972	10. 05077	1	9. 94923	50
11	22 32	37 28	65976	4	34024	71059	6	28941	05083	1	94917	49
12	22 24	37 36	66001	5	33999	71090	6	28910	05089	1	94911	48
13	22 16	37 44	66025	5	33975	71121	7	28879	05096	1	94904	47
14	22 8	37 52	66050	6	33950	71153	7	28847	05102	2	94898	46
15	8 22 0	3 38 0	9. 66075	6	10. 33925	9. 71184	8	10. 28816	10. 05109	2	9. 94891	45
16	21 52	38 8	66099	6	33901	71215	8	28785	05115	2	94885	44
17	21 44	38 16	66124	7	33876	71246	9	28754	05122	2	94878	43
18	21 36	38 24	66148	7	33852	71277	9	28723	05129	2	94871	42
19	21 28	38 32	66173	8	33827	71308	10	28692	05135	2	94865	41
20	8 21 20	3 38 40	9. 66197	8	10. 33803	9. 71339	10	10. 28661	10. 05142	2	9. 94858	40
21	21 12	38 48	66221	8	33779	71370	11	28630	05148	2	94852	39
22	21 4	38 56	66246	9	33754	71401	11	28599	05155	2	94845	38
23	20 56	39 4	66270	9	33730	71431	12	28569	05161	3	94839	37
24	20 48	39 12	66295	10	33705	71462	12	28538	05168	3	94832	36
25	8 20 40	3 39 20	9. 66319	10	10. 33681	9. 71493	13	10. 28507	10. 05174	3	9. 94826	35
26	20 32	39 28	66343	11	33657	71524	13	28476	05181	3	94819	34
27	20 24	39 36	66368	11	33632	71555	14	28445	05187	3	94813	33
28	20 16	39 44	66392	11	33608	71586	14	28414	05194	3	94806	32
29	20 8	39 52	66416	12	33584	71617	15	28383	05201	3	94799	31
30	8 20 0	3 40 0	9. 66441	12	10. 33559	9. 71648	15	10. 28352	10. 05207	3	9. 94793	30
31	19 52	40 8	66465	13	33535	71679	16	28321	05214	3	94786	29
32	19 44	40 16	66489	13	33511	71709	16	28291	05220	4	94780	28
33	19 36	40 24	66513	13	33487	71740	17	28260	05227	4	94773	27
34	19 28	40 32	66537	14	33463	71771	17	28229	05233	4	94767	26
35	8 19 20	3 40 40	9. 66562	14	10. 33438	9. 71802	18	10. 28198	10. 05240	4	9. 94760	25
36	19 12	40 48	66586	15	33414	71833	19	28167	00247	4	94753	24
37	19 4	40 56	66610	15	33390	71863	19	28137	05253	4	94747	23
38	18 56	41 4	66634	15	33366	71894	20	28106	05260	4	94740	22
39	18 48	41 12	66658	16	33342	71925	20	28075	05266	4	94734	21
40	8 18 40	3 41 20	9. 66682	16	10. 33318	9. 71955	21	10. 28045	10. 05273	4	9. 94727	20
41	18 32	41 28	66706	17	33294	71986	21	28014	05280	4	94720	19
42	18 24	41 36	66731	17	33269	72017	22	27983	05286	5	94714	18
43	18 16	41 44	66755	17	33245	72048	22	27952	05293	5	94707	17
44	18 8	41 52	66779	18	33221	72078	23	27922	05300	5	94700	16
45	8 18 0	3 42 0	9. 66803	18	10. 33197	9. 72109	23	10. 27891	10. 05306	5	9. 94694	15
46	17 52	42 8	66827	19	33173	72140	24	27860	05313	5	94687	14
47	17 44	42 16	66851	19	33149	72170	24	27830	05320	5	94680	13
48	17 36	42 24	66875	19	33125	72201	25	27799	05326	5	94674	12
49	17 28	42 32	66899	20	33101	72231	25	27769	05333	5	94667	11
50	8 17 20	3 42 40	9. 66922	20	10. 33078	9. 72262	26	10. 27738	10. 05340	5	9. 94660	10
51	17 12	42 48	66946	21	33054	72293	26	27707	05346	6	94654	9
52	17 4	42 56	66970	21	33030	72323	27	27677	05353	6	94647	8
53	16 56	43 4	66994	21	33006	72354	27	27646	05360	6	94640	7
54	16 48	43 12	67018	22	32982	72384	28	27616	05366	6	94634	6
55	8 16 40	3 43 20	9. 67042	22	10. 32958	9. 72415	28	10. 27585	10. 05373	6	9. 94627	5
56	16 32	43 28	67066	23	32934	72445	29	27555	05380	6	94620	4
57	16 24	43 36	67090	23	32910	72476	29	27524	05386	6	94614	3
58	16 16	43 44	67113	23	32887	72506	30	27494	05393	6	94607	2
59	16 8	43 52	67137	24	32863	72537	30	27463	05400	6	94600	1
60	16 0	44 0	67161	24	32839	72567	31	27433	05407	7	94593	0
M.	Hour P. M.	Hour A. M.	Cosine.	Diff.	Secant.	Cotangent.	Diff.	Tangent.	Cosecant.	Diff.	Sine.	M.

117° 63°

28°												151°
M.	Hour A. M.	Hour P. M.	Sine.	Diff.	Cosecant.	Tangent.	Diff.	Cotangent.	Secant.	Diff.	Cosine.	M.
0	8 16 0	3 44 0	9. 67161	0	10. 32839	9. 72567	0	10. 27433	10. 05407	0	9. 94593	60
1	15 52	44 8	67185	0	32815	72598	1	27402	05413	0	94587	59
2	15 44	44 16	67208	1	32792	72628	1	27372	05420	0	94580	58
3	15 36	44 24	67232	1	32768	72659	2	27341	05427	0	94573	57
4	15 28	44 32	67256	2	32744	72689	2	27311	05433	0	94567	56
5	8 15 20	3 44 40	9. 67280	2	10. 32720	9. 72720	3	10. 27280	10. 05440	1	9. 94560	55
6	15 12	44 48	67303	2	32697	72750	3	27250	05447	1	94553	54
7	15 4	44 56	67327	3	32673	72780	4	27220	05454	1	94546	53
8	14 56	45 4	67350	3	32650	72811	4	27189	05460	1	94540	52
9	14 48	45 12	67374	3	32626	72841	5	27159	05467	1	94533	51
10	8 14 40	3 45 20	9. 67398	4	10. 32602	9. 72872	5	10. 27128	10. 05474	1	9. 94526	50
11	14 32	45 28	67421	4	32579	72902	6	27098	05481	1	94519	49
12	14 24	45 36	67445	5	32555	72932	6	27068	05487	1	94513	48
13	14 16	45 44	67468	5	32532	72963	7	27037	05494	1	94506	47
14	14 8	45 52	67492	5	32508	72993	7	27007	05501	2	94499	46
15	8 14 0	3 46 0	9. 67515	6	10. 32485	9. 73023	8	10. 26977	10. 05508	2	9. 94492	45
16	13 52	46 8	67539	6	32461	73054	8	26946	05515	2	94485	44
17	13 44	46 16	67562	7	32438	73084	9	26916	05521	2	94479	43
18	13 36	46 24	67586	7	32414	73114	9	26886	05528	2	94472	42
19	13 28	46 32	67609	7	32391	73144	10	26856	05535	2	94465	41
20	8 13 20	3 46 40	9. 67633	8	10. 32367	9. 73175	10	10. 26825	10. 05542	2	9. 94458	40
21	13 12	46 48	67656	8	32344	73205	11	26795	05549	2	94451	39
22	13 4	46 56	67680	9	32320	73235	11	26765	05555	3	94445	38
23	12 56	47 4	67703	9	32297	73265	12	26735	05562	3	94438	37
24	12 48	47 12	67726	9	32274	73295	12	26705	05569	3	94431	36
25	8 12 40	3 47 20	9. 67750	10	10. 32250	9. 73326	13	10. 26674	10. 05576	3	9. 94424	35
26	12 32	47 28	67773	10	32227	73356	13	26644	05583	3	94417	34
27	12 24	47 36	67796	10	32204	73386	14	26614	05590	3	94410	33
28	12 16	47 44	67820	11	32180	73416	14	26584	05596	3	94404	32
29	12 8	47 52	67843	11	32157	73446	15	26554	05603	3	94397	31
30	8 12 0	3 48 0	9. 67866	12	10. 32134	9. 73476	15	10. 26524	10. 05610	3	9. 94390	30
31	11 52	48 8	67890	12	32110	73507	16	26493	05617	4	94383	29
32	11 44	48 16	67913	12	32087	73537	16	26463	05624	4	94376	28
33	11 36	48 24	67936	13	32064	73567	17	26433	05631	4	94369	27
34	11 28	48 32	67959	13	32041	73597	17	26403	05638	4	94362	26
35	8 11 20	3 48 40	9. 67982	14	10. 32018	9. 73627	18	10. 26373	10. 05645	4	9. 94355	25
36	11 12	48 48	68006	14	31994	73657	18	26343	05651	4	94349	24
37	11 4	48 56	68029	14	31971	73687	19	26313	05658	4	94342	23
38	10 56	49 4	68052	15	31948	73717	19	26283	05665	4	94335	22
39	10 48	49 12	68075	15	31925	73747	20	26253	05672	4	94328	21
40	8 10 40	3 49 20	9. 68098	16	10. 31902	9. 73777	20	10. 26223	10. 05679	5	9. 94321	20
41	10 32	49 28	68121	16	31879	73807	21	26193	05686	5	94314	19
42	10 24	49 36	68144	16	31856	73837	21	26163	05693	5	94307	18
43	10 16	49 44	68167	17	31833	73867	22	26133	05700	5	94300	17
44	10 8	49 52	68190	17	31810	73897	22	26103	05707	5	94293	16
45	8 10 0	3 50 0	9. 68213	17	10. 31787	9. 73927	23	10. 26073	10. 05714	5	9. 94286	15
46	9 52	50 8	68237	18	31763	73957	23	26043	05721	5	94279	14
47	9 44	50 16	68260	18	31740	73987	24	26013	05727	5	94273	13
48	9 36	50 24	68283	19	31717	74017	24	25983	05734	5	94266	12
49	9 28	50 32	68305	19	31695	74047	25	25953	05741	6	94259	11
50	8 9 20	3 50 40	9. 68328	19	10. 31672	9. 74077	25	10. 25923	10. 05748	6	9. 94252	10
51	9 12	50 48	68351	20	31649	74107	26	25893	05755	6	94245	9
52	9 4	50 56	68374	20	31626	74137	26	25863	05762	6	94238	8
53	8 56	51 4	68397	21	31603	74166	27	25834	05769	6	94231	7
54	8 48	51 12	68420	21	31580	74196	27	25804	05776	6	94224	6
55	8 8 40	3 51 20	9. 68443	21	10. 31557	9. 74226	28	10. 25774	10. 05783	6	9. 94217	5
56	8 32	51 28	68466	22	31534	74256	28	25744	05790	6	94210	4
57	8 24	51 36	68489	22	31511	74286	29	25714	05797	7	94203	3
58	8 16	51 44	68512	22	31488	74316	29	25684	05804	7	94196	2
59	8 8	51 52	68534	23	31466	74345	30	25655	05811	7	94189	1
60	8 0	52 0	68557	23	31443	74375	30	25625	05818	7	94182	0
M.	Hour P. M.	Hour A. M.	Cosine.	Diff.	Secant.	Cotangent.	Diff.	Tangent.	Cosecant.	Diff.	Sine.	M.
118°												61°

SINES, TANGENTS, AND SECANTS.

29° — 150°

M	Hour A. M.	Hour P. M.	Sine.	Diff.	Cosecant.	Tangent.	Diff.	Cotangent.	Secant.	Diff.	Cosine.	M.
0	8 8 0	3 52 0	9. 68557	0	10. 31443	9. 74375	0	10. 25625	10. 05818	0	9. 94182	60
1	7 52	52 8	68580	0	31420	74405	0	25595	05825	0	94175	59
2	7 44	52 16	68603	1	31397	74435	1	25565	05832	0	94168	58
3	7 36	52 24	68625	1	31375	74465	1	25535	05839	0	94161	57
4	7 28	52 32	68648	1	31352	74494	2	25506	05846	0	94154	56
5	8 7 20	3 52 40	9. 68671	2	10. 31329	9. 74524	2	10. 25476	10. 05853	1	9. 94147	55
6	7 12	52 48	68694	2	31306	74554	3	25446	05860	1	94140	54
7	7 4	52 56	68716	3	31284	74583	3	25417	05867	1	94133	53
8	6 56	53 4	68739	3	31261	74613	4	25387	05874	1	94126	52
9	6 48	53 12	68762	3	31238	74643	4	25357	05881	1	94119	51
10	8 6 40	3 53 20	9. 68784	4	10. 31216	9. 74673	5	10. 25327	10. 05888	1	9. 94112	50
11	6 32	53 28	68807	4	31193	74702	5	25298	05895	1	94105	49
12	6 24	53 36	68829	4	31171	74732	6	25268	05902	1	94098	48
13	6 16	53 44	68852	5	31148	74762	6	25238	05910	2	94090	47
14	6 8	53 52	68875	5	31125	74791	7	25209	05917	2	94083	46
15	8 6 0	3 54 0	9. 68897	6	10. 31103	9. 74821	7	10. 25179	10. 05924	2	9. 94076	45
16	5 52	54 8	68920	6	31080	74851	8	25149	05931	2	94069	44
17	5 44	54 16	68942	6	31058	74880	8	25120	05938	2	94062	43
18	5 36	54 24	68965	7	31035	74910	9	25090	05945	2	94055	42
19	5 28	54 32	68987	7	31013	74939	9	25061	05952	2	94048	41
20	8 5 20	3 54 40	9. 69010	7	10. 30990	9. 74969	10	10. 25031	10. 05959	2	9. 94041	40
21	5 12	54 48	69032	8	30968	74998	10	25002	05966	3	94034	39
22	5 4	54 56	69055	8	30945	75028	11	24972	05973	3	94027	38
23	4 56	55 4	69077	9	30923	75058	11	24942	05980	3	94020	37
24	4 48	55 12	69100	9	30900	75087	12	24913	05988	3	94012	36
25	8 4 40	3 55 20	9. 69122	9	10. 30878	9. 75117	12	10. 24883	10. 05995	3	9. 94005	35
26	4 32	55 28	69144	10	30856	75146	13	24854	06002	3	93998	34
27	4 24	55 36	69167	10	30833	75176	13	24824	06009	3	93991	33
28	4 16	55 44	69189	10	30811	75205	14	24795	06016	3	93984	32
29	4 8	55 52	69212	11	30788	75235	14	24765	06023	3	93977	31
30	8 4 0	3 56 0	9. 69234	11	10. 30766	9. 75264	15	10. 24736	10. 06030	4	9. 93970	30
31	3 52	56 8	69256	12	30744	75294	15	24706	06037	4	93963	29
32	3 44	56 16	69279	12	30721	75323	16	24677	06045	4	93955	28
33	3 36	56 24	69301	12	30699	75353	16	24647	06052	4	93948	27
34	3 28	56 32	69323	13	30677	75382	17	24618	06059	4	93941	26
35	8 3 20	3 56 40	9. 69345	13	10. 30655	9. 75411	17	10. 24589	10. 06066	4	9. 93934	25
36	3 12	56 48	69368	13	30632	75441	18	24559	06073	4	93927	24
37	3 4	56 56	69390	14	30610	75470	18	24530	06080	4	93920	23
38	2 56	57 4	69412	14	30588	75500	19	24500	06088	5	93912	22
39	2 48	57 12	69434	15	30566	75529	19	24471	06095	5	93905	21
40	8 2 40	3 57 20	9. 69456	15	10. 30544	9. 75558	20	10. 24442	10. 06102	5	9. 93898	20
41	2 32	57 28	69479	15	30521	75588	20	24412	06109	5	93891	19
42	2 24	57 36	69501	16	30499	75617	21	24383	06116	5	93884	18
43	2 16	57 44	69523	16	30477	75647	21	24353	06124	5	93876	17
44	2 8	57 52	69545	16	30455	75676	22	24324	06131	5	93869	16
45	8 2 0	3 58 0	9. 69567	17	10. 30433	9. 75705	22	10. 24295	10. 06138	5	9. 93862	15
46	1 52	58 8	69589	17	30411	75735	23	24265	06145	5	93855	14
47	1 44	58 16	69611	17	30389	75764	23	24236	06153	6	93847	13
48	1 36	58 24	69633	18	30367	75793	24	24207	06160	6	93840	12
49	1 28	58 32	69655	18	30345	75822	24	24178	06167	6	93833	11
50	8 1 20	3 58 40	9. 69677	19	10. 30323	9. 75852	25	10. 24148	10. 06174	6	9. 93826	10
51	1 12	58 48	69699	19	30301	75881	25	24119	06181	6	93819	9
52	1 4	58 56	69721	19	30279	75910	26	24090	06189	6	93811	8
53	0 56	59 4	69743	20	30257	75939	26	24061	06196	6	93804	7
54	0 48	59 12	69765	20	30235	75969	27	24031	06203	6	93797	6
55	8 0 49	3 59 20	9. 69787	20	10. 30213	9. 75998	27	10. 24002	10. 06211	7	9. 93789	5
56	0 32	59 28	69809	21	30191	76027	28	23973	06218	7	93782	4
57	0 24	59 36	69831	21	30169	76056	28	23944	06225	7	93775	3
58	0 16	59 44	69853	21	30147	76086	29	23914	06232	7	93768	2
59	0 8	59 52	69875	22	30125	76115	29	23885	06240	7	93760	1
60	0 0	4 0 0	69897	22	30103	76144	29	23856	06247	7	93753	0
M.	Hour P. M.	Hour A. M.	Cosine.	Diff.	Secant.	Cotangent.	Diff.	Tangent.	Cosecant.	Diff.	Sine.	M.

119° — 60°

30°												119°
M.	Hour A. M.	Hour P. M.	Sine.	Diff.	Cosecant.	Tangent.	Diff.	Cotangent.	Secant.	Diff.	Cosine.	M.
0	8 0 0	4 0 0	9. 69897	0	10. 30103	9. 76144	0	10. 23856	10. 06247	0	9. 93753	60
1	7 59 52	0 8	69919	0	30081	76173	0	23827	06254	0	93746	59
2	59 44	0 16	69941	1	30059	76202	1	23798	06262	0	93738	58
3	59 36	0 24	69963	1	30037	76231	1	23769	06269	0	93731	57
4	59 28	0 32	69984	1	30016	76261	2	23739	06276	0	93724	56
5	7 59 20	4 0 40	9. 70006	2	10. 29994	9. 76290	2	10. 23710	10. 06283	1	9. 93717	55
6	59 12	0 48	70028	2	29972	76319	3	23681	06291	1	93709	54
7	59 4	0 56	70050	3	29950	76348	3	23652	06298	1	93702	53
8	58 56	1 4	70072	3	29928	76377	4	23623	06305	1	93695	52
9	58 48	1 12	70093	3	29907	76406	4	23594	06313	1	93687	51
10	7 58 40	4 1 20	9. 70115	4	10. 29885	9. 76435	5	10. 23565	10. 06320	1	9. 93680	50
11	58 32	1 28	70137	4	29863	76464	5	23536	06327	1	93673	49
12	58 24	1 36	70159	4	29841	76493	6	23507	06335	1	93665	48
13	58 16	1 44	70180	5	29820	76522	6	23478	06342	2	93658	47
14	58 8	1 52	70202	5	29798	76551	7	23449	06350	2	93650	46
15	7 58 0	4 2 0	9. 70224	5	10. 29776	9. 76580	7	10. 23420	10. 06357	2	9. 93643	45
16	57 52	2 8	70245	6	29755	76609	8	23391	06364	2	93636	44
17	57 44	2 16	70267	6	29733	76639	8	23361	06372	2	93628	43
18	57 36	2 24	70288	6	29712	76668	9	23332	06379	2	93621	42
19	57 28	2 32	70310	7	29690	76697	9	23303	06386	2	93614	41
20	7 57 20	4 2 40	9. 70332	7	10. 29668	9. 76725	10	10. 23275	10. 06394	2	9. 93606	40
21	57 12	2 48	70353	8	29647	76754	10	23246	06401	3	93599	39
22	57 4	2 56	70375	8	29625	76783	11	23217	06409	3	93591	38
23	56 56	3 4	70396	8	29604	76812	11	23188	06416	3	93584	37
24	56 48	3 12	70418	9	29582	76841	12	23159	06423	3	93577	36
25	7 56 40	4 3 20	9. 70439	9	10. 29561	9. 76870	12	10. 23130	10. 06431	3	9. 93569	35
26	56 32	3 28	70461	9	29539	76899	13	23101	06438	3	93562	34
27	56 24	3 36	70482	10	29518	76928	13	23072	06446	3	93554	33
28	56 16	3 44	70504	10	29496	76957	13	23043	06453	3	93547	32
29	56 8	3 52	70525	10	29475	76986	14	23014	06461	4	93539	31
30	7 56 0	4 4 0	9. 70547	11	10. 29453	9. 77015	14	10. 22985	10. 06468	4	9. 93532	30
31	55 52	4 8	70568	11	29432	77044	15	22956	06475	4	93525	29
32	55 44	4 16	70590	11	29410	77073	15	22927	06483	4	93517	28
33	55 36	4 24	70611	12	29389	77101	16	22899	06490	4	93510	27
34	55 28	4 32	70633	12	29367	77130	16	22870	06498	4	93502	26
35	7 55 20	4 4 40	9. 70654	13	10. 29346	9. 77159	17	10. 22841	10. 06505	4	9. 93495	25
36	55 12	4 48	70675	13	29325	77188	17	22812	06513	4	93487	24
37	55 4	4 56	70697	13	29303	77217	18	22783	06520	5	93480	23
38	54 56	5 4	70718	14	29282	77246	18	22754	06528	5	93472	22
39	54 48	5 12	70739	14	29261	77274	19	22726	06535	5	93465	21
40	7 54 40	4 5 20	9. 70761	14	10. 29239	9. 77303	19	10. 22697	10. 06543	5	9. 93457	20
41	54 32	5 28	70782	15	29218	77332	20	22668	06550	5	93450	19
42	54 24	5 36	70803	15	29197	77361	20	22639	06558	5	93442	18
43	54 16	5 44	70824	15	29176	77390	21	22610	06565	5	93435	17
44	54 8	5 52	70846	16	29154	77418	21	22582	06573	5	93427	16
45	7 54 0	4 6 0	9. 70867	16	10. 29133	9. 77447	22	10. 22553	10. 06580	6	9. 93420	15
46	53 52	6 8	70888	16	29112	77476	22	22524	06588	6	93412	14
47	53 44	6 16	70909	17	29091	77505	23	22495	06595	6	93405	13
48	53 36	6 24	70931	17	29069	77533	23	22467	06603	6	93397	12
49	53 28	6 32	70952	18	29048	77562	24	22438	06610	6	93390	11
50	7 53 20	4 6 40	9. 70973	18	10. 29027	9. 77591	24	10. 22409	10. 06618	6	9. 93382	10
51	53 12	6 48	70994	18	29006	77619	25	22381	06625	6	93375	9
52	53 4	6 56	71015	19	28985	77648	25	22352	06633	6	93367	8
53	52 56	7 4	71036	19	28964	77677	26	22323	06640	7	93360	7
54	52 48	7 12	71058	19	28942	77706	26	22294	06648	7	93352	6
55	7 52 40	4 7 20	9. 71079	20	10. 28921	9. 77734	26	10. 22266	10. 06656	7	9. 93344	5
56	52 32	7 28	71100	20	28900	77763	27	22237	06663	7	93337	4
57	52 24	7 36	71121	20	28879	77791	27	22209	06671	7	93329	3
58	52 16	7 44	71142	21	28858	77820	28	22180	06678	7	93322	2
59	52 8	7 52	71163	21	28837	77849	28	22151	06686	7	93314	1
60	52 0	8 0	71184	21	28816	77877	29	22123	06693	7	93307	0
M.	Hour P. M.	Hour A. M.	Cosine.	Diff.	Secant.	Cotangent.	Diff.	Tangent.	Cosecant.	Diff.	Sine.	M.
120°												59°

SINES, TANGENTS, AND SECANTS.

31°											148°
M.	Hour A. M.	Hour P. M.	Sine.	Diff.	Cosecant.	Tangent.	Diff.	Cotangent.	Secant.	Diff.	Cosine.	M.
0	7 52 0	4 8 0	9. 71184	0	10. 28816	9. 77877	0	10. 22123	10. 06693	0	9. 93307	60
1	51 52	8 8	71205	0	28795	77906	0	22094	06701	0	93299	59
2	51 44	8 16	71226	1	28774	77935	1	22065	06709	0	93291	58
3	51 36	8 24	71247	1	28753	77963	1	22037	06716	0	93284	57
4	51 28	8 32	71268	1	28732	77992	2	22008	06724	1	93276	56
5	7 51 20	4 8 40	9. 71289	2	10. 28711	9. 78020	2	10. 21980	10. 06731	1	9. 93269	55
6	51 12	8 48	71310	2	28690	78049	3	21951	06739	1	93261	54
7	51 4	8 56	71331	2	28669	78077	3	21923	06747	1	93253	53
8	50 56	9 4	71352	3	28648	78106	4	21894	06754	1	93246	52
9	50 48	9 12	71373	3	28627	78135	4	21865	06762	1	93238	51
10	7 50 40	4 9 20	9. 71393	3	10. 28607	9. 78163	5	10. 21837	10. 06770	1	9. 93230	50
11	50 32	9 28	71414	4	28586	78192	5	21808	06777	1	93223	49
12	50 24	9 36	71435	4	28565	78220	6	21780	06785	2	93215	48
13	50 16	9 44	71456	4	28544	78249	6	21751	06793	2	93207	47
14	50 8	9 52	71477	5	28523	78277	7	21723	06800	2	93200	46
15	7 50 0	4 10 0	9. 71498	5	10. 28502	9. 78306	7	10. 21694	10. 06808	2	9. 93192	45
16	49 52	10 8	71519	5	28481	78334	8	21666	06816	2	93184	44
17	49 44	10 16	71539	6	28461	78363	8	21637	06823	2	93177	43
18	49 36	10 24	71560	6	28440	78391	9	21609	06831	2	93169	42
19	49 28	10 32	71581	7	28419	78419	9	21581	06839	2	93161	41
20	7 49 20	4 10 40	9. 71602	7	10. 28398	9. 78448	9	10. 21552	10. 06846	3	9. 93154	40
21	49 12	10 48	71622	7	28378	78476	10	21524	06854	3	93146	39
22	49 4	10 56	71643	8	28357	78505	10	21495	06862	3	93138	38
23	48 56	11 4	71664	8	28336	78533	11	21467	06869	3	93131	37
24	48 48	11 12	71685	8	28315	78562	11	21438	06877	3	93123	36
25	7 48 40	4 11 20	9. 71705	9	10. 28295	9. 78590	12	10. 21410	10. 06885	3	9. 93115	35
26	48 32	11 28	71726	9	28274	78618	12	21382	06892	3	93108	34
27	48 24	11 36	71747	9	28253	78647	13	21353	06900	3	93100	33
28	48 16	11 44	71767	10	28233	78675	13	21325	06908	4	93092	32
29	48 8	11 52	71788	10	28212	78704	14	21296	06916	4	93084	31
30	7 48 0	4 12 0	9. 71809	10	10. 28191	9. 78732	14	10. 21268	10. 06923	4	9. 93077	30
31	47 52	12 8	71829	11	28171	78760	15	21240	06931	4	93069	29
32	47 44	12 16	71850	11	28150	78789	15	21211	06939	4	93061	28
33	47 36	12 24	71870	11	28130	78817	16	21183	06947	4	93053	27
34	47 28	12 32	71891	12	28109	78845	16	21155	06954	4	93046	26
35	7 47 20	4 12 40	9. 71911	12	10. 28089	9. 78874	17	10. 21126	10. 06962	5	9. 93038	25
36	47 12	12 48	71932	12	28068	78902	17	21098	06970	5	93030	24
37	47 4	12 56	71952	13	28048	78930	17	21070	06978	5	93022	23
38	46 56	13 4	71973	13	28027	78959	18	21041	06986	5	93014	22
39	46 48	13 12	71994	13	28006	78987	18	21013	06993	5	93007	21
40	7 46 40	4 13 20	9. 72014	14	10. 27986	9. 79015	19	10. 20985	10. 07001	5	9. 92999	20
41	46 32	13 28	72034	14	27966	79043	19	20957	07009	5	92991	19
42	46 24	13 36	72055	14	27945	79072	20	20928	07017	5	92983	18
43	46 16	13 44	72075	15	27925	79100	20	20900	07024	6	92976	17
44	46 8	13 52	72096	15	27904	79128	21	20872	07032	6	92968	16
45	7 46 0	4 14 0	9. 72116	15	10. 27884	9. 79156	21	10. 20844	10. 07040	6	9. 92960	15
46	45 52	14 8	72137	16	27863	79185	22	20815	07048	6	92952	14
47	45 44	14 16	72157	16	27843	79213	22	20787	07056	6	92944	13
48	45 36	14 24	72177	16	27823	79241	23	20759	07064	6	92936	12
49	45 28	14 32	72198	17	27802	79269	23	20731	07071	6	92929	11
50	7 45 20	4 14 40	9. 72218	17	10. 27782	9. 79297	24	10. 20703	10. 07079	6	9. 92921	10
51	45 12	14 48	72238	18	27762	79326	24	20674	07087	7	92913	9
52	45 4	14 56	72259	18	27741	79354	25	20646	07095	7	92905	8
53	44 56	15 4	72279	18	27721	79382	25	20618	07103	7	92897	7
54	44 48	15 12	72299	19	27701	79410	26	20590	07111	7	92889	6
55	7 44 40	4 15 20	9. 72320	19	10. 27680	9. 79438	26	10. 20562	10. 07119	7	9. 92881	5
56	44 32	15 28	72340	19	27660	79466	26	20534	07126	7	92874	4
57	44 24	15 36	72360	20	27640	79495	27	20505	07134	7	92866	3
58	44 16	15 44	72381	20	27619	79523	27	20477	07142	7	92858	2
59	44 8	15 52	72401	20	27599	79551	28	20449	07150	8	92850	1
60	44 0	16 0	72421	21	27579	79579	28	20421	07158	8	92842	0
M.	Hour P. M.	Hour A. M.	Cosine.	Diff.	Secant.	Cotangent.	Diff.	Tangent.	Cosecant.	Diff.	Sine.	M.
121°												58°

SINES, TANGENTS, AND SECANTS.

82°													147°
M.	Hour A. M.	Hour P. M.	Sine.	Dif.	Cosecant.	Tangent.	Dif.	Cotangent.	Secant.	Dif.	Cosine.	M.
0	7 44 0	4 16 0	9. 72421	0	10. 27579	9. 79579	0	10. 20421	10. 07158	0	9. 92842	60
1	43 52	16 8	72441	0	27559	79607	0	20393	07166	0	92834	59
2	43 44	16 16	72461	1	27539	79635	1	20365	07174	0	92826	58
3	43 36	16 24	72482	1	27518	79663	1	20337	07182	0	92818	57
4	43 28	16 32	72502	1	27498	79691	2	20309	07190	1	92810	56
5	7 43 20	4 16 40	9. 72522	2	10. 27478	9. 79719	2	10. 20281	10. 07197	1	9. 92803	55
6	43 12	16 48	72542	2	27458	79747	3	20253	07205	1	92795	54
7	43 4	16 56	72562	2	27438	79776	3	20224	07213	1	92787	53
8	42 56	17 4	72582	3	27418	79804	4	20196	07221	1	92779	52
9	42 48	17 12	72602	3	27398	79832	4	20168	07229	1	92771	51
10	7 42 40	4 17 20	9. 72622	3	10. 27378	9. 79860	5	10. 20140	10. 07237	1	9. 92763	50
11	42 32	17 28	72643	4	27357	79888	5	20112	07245	1	92755	49
12	42 24	17 36	72663	4	27337	79916	6	20084	07253	2	92747	48
13	42 16	17 44	72683	4	27317	79944	6	20056	07261	2	92739	47
14	42 8	17 52	72703	5	27297	79972	7	20028	07269	2	92731	46
15	7 42 0	4 18 0	9. 72723	5	10. 27277	9. 80000	7	10. 20000	10. 07277	2	9. 92723	45
16	41 52	18 8	72743	5	27257	80028	7	19972	07285	2	92715	44
17	41 44	18 16	72763	6	27237	80056	8	19944	07293	2	92707	43
18	41 36	18 24	72783	6	27217	80084	8	19916	07301	2	92699	42
19	41 28	18 32	72803	6	27197	80112	9	19888	07309	3	92691	41
20	7 41 20	4 18 40	9. 72823	7	10. 27177	9. 80140	9	10. 19860	10. 07317	3	9. 92683	40
21	41 12	18 48	72843	7	27157	80168	10	19832	07325	3	92675	39
22	41 4	18 56	72863	7	27137	80195	10	19805	07333	3	92667	38
23	40 56	19 4	72883	8	27117	80223	11	19777	07341	3	92659	37
24	40 48	19 12	72902	8	27098	80251	11	19749	07349	3	92651	36
25	7 40 40	4 19 20	9. 72922	8	10. 27078	9. 80279	12	10. 19721	10. 07357	3	9. 92643	35
26	40 32	19 28	72942	9	27058	80307	12	19693	07365	3	92635	34
27	40 24	19 36	72962	9	27038	80335	13	19665	07373	4	92627	33
28	40 16	19 44	72982	9	27018	80363	13	19637	07381	4	92619	32
29	40 8	19 52	73002	10	26998	80391	13	19609	07389	4	92611	31
30	7 40 0	4 20 0	9. 73022	10	10. 26978	9. 80419	14	10. 19581	10. 07397	4	9. 92603	30
31	39 52	20 8	73041	10	26959	80447	14	19553	07405	4	92595	29
32	39 44	20 16	73061	11	26939	80474	15	19526	07413	4	92587	28
33	39 36	20 24	73081	11	26919	80502	15	19498	07421	4	92579	27
34	39 28	20 32	73101	11	26899	80530	16	19470	07429	5	92571	26
35	7 39 20	4 20 40	9. 73121	12	10. 26879	9. 80558	16	10. 19442	10. 07437	5	9. 92563	25
36	39 12	20 48	73140	12	26860	80586	17	19414	07445	5	92555	24
37	39 4	20 56	73160	12	26840	80614	17	19386	07454	5	92546	23
38	38 56	21 4	73180	13	26820	80642	18	19358	07462	5	92538	22
39	38 48	21 12	73200	13	26800	80669	18	19331	07470	5	92530	21
40	7 38 40	4 21 20	9. 73219	13	10. 26781	9. 80697	19	10. 19303	10. 07478	6	9. 92522	20
41	38 32	21 28	73239	14	26761	80725	19	19275	07486	6	92514	19
42	38 24	21 36	73259	14	26741	80753	20	19247	07494	6	92506	18
43	38 16	21 44	73278	14	26722	80781	20	19219	07502	6	92498	17
44	38 8	21 52	73298	15	26702	80808	20	19192	07510	6	92490	16
45	7 38 0	4 22 0	9. 73318	15	10. 26682	9. 80836	21	10. 19164	10. 07518	6	9. 92482	15
46	37 52	22 8	73337	15	26663	80864	21	19136	07527	6	92473	14
47	37 44	22 16	73357	16	26643	80892	22	19108	07535	6	92465	13
48	37 36	22 24	73377	16	26623	80919	22	19081	07543	6	92457	12
49	37 28	22 32	73396	16	26604	80947	23	19053	07551	7	92449	11
50	7 37 20	4 22 40	9. 73416	17	10. 26584	9. 80975	23	10. 19025	10. 07559	7	9. 92441	10
51	37 12	22 48	73435	17	26565	81003	24	18997	07567	7	92433	9
52	37 4	22 56	73455	17	26545	81030	24	18970	07575	7	92425	8
53	36 56	23 4	73474	18	26526	81058	25	18942	07584	7	92416	7
54	36 48	23 12	73494	18	26506	81086	25	18914	07592	7	92408	6
55	7 36 40	4 23 20	9. 73513	18	10. 26487	9. 81113	26	10. 18887	10. 07600	7	9. 92400	5
56	36 32	23 28	73533	19	26467	81141	26	18859	07608	8	92392	4
57	36 24	23 36	73552	19	26448	81169	26	18831	07616	8	92384	3
58	30 16	23 44	73572	19	26428	81196	27	18804	07624	8	92376	2
59	36 8	23 52	73591	20	26409	81224	27	18776	07633	8	92367	1
60	36 0	24 0	73611	20	26389	81252	28	18748	07641	8	92359	0
M.	Hour P. M.	Hour A. M.	Cosine.	Dif.	Secant.	Cotangent.	Dif.	Tangent.	Cosecant.	Dif.	Sine.	N.
122°												57°

SINES, TANGENTS, AND SECANTS.

33° 146°

M.	Hour A. M.	Hour P. M.	Sine.	Diff.	Cosecant.	Tangent.	Diff.	Cotangent.	Secant.	Diff.	Cosine.	M.
0	7 36 0	4 24 0	9. 73611	0	10. 26389	9. 81252	0	10. 18748	10. 07641	0	9. 92359	60
1	35 52	24 8	73630	0	26370	81279	0	18721	07649	0	92351	59
2	35 44	24 16	73650	1	26350	81307	1	18693	07657	0	92343	58
3	35 36	24 24	73669	1	26331	81335	1	18665	07665	0	92335	57
4	35 28	24 32	73689	1	26311	81362	2	18638	07674	1	92326	56
5	7 35 20	4 24 40	9. 73708	2	10. 26292	9. 81390	2	10. 18610	10. 07682	1	9. 92318	55
6	35 12	24 48	73727	2	26273	81418	3	18582	07690	1	92310	54
7	35 4	24 56	73747	2	26253	81445	3	18555	07698	1	92302	53
8	34 56	25 4	73766	3	26234	81473	4	18527	07707	1	92293	52
9	34 48	25 12	73785	3	26215	81500	4	18500	07715	1	92285	51
10	7 34 40	4 25 20	9. 76805	3	10. 26195	9. 81528	5	10. 18472	10. 07723	1	9. 92277	50
11	34 32	25 28	73824	3	26176	81556	5	18444	07731	2	92269	49
12	34 24	25 36	73843	4	26157	81583	5	18417	07740	2	92260	48
13	34 16	25 44	73863	4	26137	81611	6	18389	07748	2	92252	47
14	34 8	25 52	73882	4	26118	81638	6	18362	07756	2	92244	46
15	7 34 0	4 26 0	9. 73901	5	10. 26099	9. 81666	7	10. 18334	10. 07765	2	9. 92235	45
16	33 52	26 8	73921	5	26079	81693	7	18307	07773	2	92227	44
17	33 44	26 16	73940	5	26060	81721	8	18279	07781	2	92219	43
18	33 36	26 24	73959	6	26041	81748	8	18252	07789	3	92211	42
19	33 28	26 32	73978	6	26022	81776	9	18224	07798	3	92202	41
20	7 33 20	4 26 40	9. 73997	6	10. 26003	9. 81803	9	10. 18197	10. 07806	3	9. 92194	40
21	33 12	26 48	74017	7	25983	81831	10	18169	07814	3	92186	39
22	33 4	26 56	74036	7	25964	81858	10	18142	07823	3	92177	38
23	32 56	27 4	74055	7	25945	81886	11	18114	07831	3	92169	37
24	32 48	27 12	74074	8	25926	81913	11	18087	07839	3	92161	36
25	7 32 40	4 27 20	9. 74093	8	10. 25907	9. 81941	11	10. 18059	10. 07848	3	9. 92152	35
26	32 32	27 28	74113	8	25887	81968	12	18032	07856	4	92144	34
27	32 24	27 36	74132	9	25868	81996	12	18004	07864	4	92136	33
28	32 16	27 44	74151	9	25849	82023	13	17977	07873	4	92127	32
29	32 8	27 52	74170	9	25830	82051	13	17949	07881	4	92119	31
30	7 32 0	4 28 0	9. 74189	10	10. 25811	9. 82078	14	10. 17922	10. 07889	4	9. 92111	30
31	31 52	28 8	74208	10	25792	82106	14	17894	07898	4	92102	29
32	31 44	28 16	74227	10	25773	82133	15	17867	07906	4	92094	28
33	31 36	28 24	74246	10	25754	82161	15	17839	07914	5	92086	27
34	31 28	28 32	74265	11	25735	82188	16	17812	07923	5	92077	26
35	7 31 20	4 28 40	9. 74284	11	10. 25716	9. 82215	16	10. 17785	10. 07931	5	9. 92069	25
36	31 12	28 48	74303	11	25697	82243	16	17757	07940	5	92060	24
37	31 4	28 56	74322	12	25678	82270	17	17730	07948	5	92052	23
38	30 56	29 4	74341	12	25659	82298	17	17702	07956	5	92044	22
39	30 48	29 12	74360	12	25640	82325	18	17675	07965	5	92035	21
40	7 30 40	4 29 20	9. 74379	13	10. 25621	9. 82352	18	10. 17648	10. 07973	6	9. 92027	20
41	30 32	29 28	74398	13	25602	82380	19	17620	07982	6	92018	19
42	30 24	29 36	74417	13	25583	82407	19	17593	07990	6	92010	18
43	30 16	29 44	74436	14	25564	82435	20	17565	07998	6	92002	17
44	30 8	29 52	74455	14	25545	82462	20	17538	08007	6	91993	16
45	7 30 0	4 30 0	9. 74474	14	10. 25526	9. 82489	21	10. 17511	10. 08015	6	9. 91985	15
46	29 52	30 8	74493	15	25507	82517	21	17483	08024	6	91976	14
47	29 44	30 16	74512	15	25488	82544	22	17456	08032	7	91968	13
48	29 36	30 24	74531	15	25469	82571	22	17429	08041	7	91959	12
49	29 28	30 32	74549	16	25451	82599	22	17401	08049	7	91951	11
50	7 29 20	4 30 40	9. 74568	16	10. 25432	9. 82626	23	10. 17374	10. 08058	7	9. 91942	10
51	29 12	30 48	74587	16	25413	82653	23	17347	08066	7	91934	9
52	29 4	30 56	74606	17	25394	82681	24	17319	08075	7	91925	8
53	28 56	31 4	74625	17	25375	82708	24	17292	08083	7	91917	7
54	28 48	31 12	74644	17	25356	82735	25	17265	08092	8	91908	6
55	7 28 40	4 31 20	9. 74662	17	10. 25338	9. 82762	25	10. 17238	10. 08100	8	9. 91900	5
56	28 32	31 28	74681	18	25319	82790	26	17210	08109	8	91891	4
57	28 24	31 36	74700	18	25300	82817	26	17183	08117	8	91883	3
58	28 16	31 44	74719	18	25281	82844	27	17156	08126	8	91874	2
59	28 8	31 52	74737	19	25263	82871	27	17129	08134	8	91866	1
60	28 0	32 0	74756	19	25244	82899	27	17101	08143	8	91857	0
M.	Hour P. M.	Hour A. M.	Cosine.	Diff.	Secant.	Cotangent.	Diff.	Tangent.	Cosecant.	Diff.	Sine.	M.

123° 56°

34° 115°

M.	Hour A. M.	Hour P. M.	Sine.	Diff.	Cosecant.	Tangent.	Diff.	Cotangent.	Secant	Diff.	Cosine.	M.
0	7 28 0	4 32 0	9. 74756	0	10. 25244	9. 82899	0	10. 17101	10. 08143	0	9. 91857	60
1	27 52	32 8	74775	0	25225	82926	0	17074	08151	0	91849	59
2	27 44	32 16	74794	1	25206	82953	1	17047	08160	0	91840	58
3	27 36	32 24	74812	1	25188	82980	1	17020	08168	0	91832	57
4	27 28	32 32	74831	1	25169	83008	2	16992	08177	1	91823	56
5	7 27 20	4 32 40	9. 74850	2	10. 25150	9. 83035	2	10. 16965	10. 08185	1	9. 91815	55
6	27 12	32 48	74868	2	25132	83062	3	16938	08194	1	91806	54
7	27 4	32 56	74887	2	25113	83089	3	16911	08202	1	91798	53
8	26 56	33 4	74906	2	25094	83117	4	16883	08211	1	91789	52
9	26 48	33 12	74924	3	25076	83144	4	16856	08219	1	91781	51
10	7 26 40	4 33 20	9. 74943	3	10. 25057	9. 83171	5	10. 16829	10. 08228	1	9. 91772	50
11	26 32	33 28	74961	3	25039	83198	5	16802	08237	2	91763	49
12	26 24	33 36	74980	4	25020	83225	5	16775	08245	2	91755	48
13	26 16	33 44	74999	4	25001	83252	6	16748	08254	2	91746	47
14	26 8	33 52	75017	4	24983	83280	6	16720	08262	2	91738	46
15	7 26 0	4 34 0	9. 75036	5	10. 24964	9. 83307	7	10. 16693	10. 08271	2	9. 91729	45
16	25 52	34 8	75054	5	24946	83334	7	16666	08280	2	91720	44
17	25 44	34 16	75073	5	24927	83361	8	16639	08288	2	91712	43
18	25 36	34 24	75091	6	24909	83388	8	16612	08297	3	91703	42
19	25 28	34 32	75110	6	24890	83415	9	16585	08305	3	91695	41
20	7 25 20	4 34 40	9. 75128	6	10. 24872	9. 83442	9	10. 16558	10. 08314	3	9. 91686	40
21	25 12	34 48	75147	6	24853	83470	9	16530	08323	3	91677	39
22	25 4	34 56	75165	7	24835	83497	10	16503	08331	3	91669	38
23	24 56	35 4	75184	7	24816	83524	10	16476	08340	3	91660	37
24	24 48	35 12	75202	7	24798	83551	11	16449	08349	3	91651	36
25	7 24 40	4 35 20	9. 75221	8	10. 24779	9. 83578	11	10. 16422	10. 08357	4	9. 91643	35
26	24 32	35 28	75239	8	24761	83605	12	16395	08366	4	91634	34
27	24 24	35 36	75258	8	24742	83632	12	16368	08375	4	91625	33
28	24 16	35 44	75276	9	24724	83659	13	16341	08383	4	91617	32
29	24 8	35 52	75294	9	24706	83686	13	16314	08392	4	91608	31
30	7 24 0	4 36 0	9. 75313	9	10. 24687	9. 83713	14	10. 16287	10. 08401	4	9. 91599	30
31	23 52	36 8	75331	9	24669	83740	14	16260	08409	4	91591	29
32	23 44	36 16	75350	10	24650	83768	14	16232	08418	5	91582	28
33	23 36	36 24	75368	10	24632	83795	15	16205	08427	5	91573	27
34	23 28	36 32	75386	10	24614	83822	15	16178	08435	5	91565	26
35	7 23 20	4 36 40	9. 75405	11	10. 24595	9. 83849	16	10. 16151	10. 08444	5	9. 91556	25
36	23 12	36 48	75423	11	24577	83876	16	16124	08453	5	91547	24
37	23 4	36 56	75441	11	24559	83903	17	16097	08462	5	91538	23
38	22 56	37 4	75459	12	24541	83930	17	16070	08470	5	91530	22
39	22 48	37 12	75478	12	24522	83957	18	16043	08479	6	91521	21
40	7 22 40	4 37 20	9. 75496	12	10. 24504	9. 83984	18	10. 16016	10. 08488	6	9. 91512	20
41	22 32	37 28	75514	13	24486	84011	18	15989	08496	6	91504	19
42	22 24	37 36	75533	13	24467	84038	19	15962	08505	6	91495	18
43	22 16	37 44	75551	13	24449	84065	19	15935	08514	6	91486	17
44	22 8	37 52	75569	13	24431	84092	20	15908	08523	6	91477	16
45	7 22 0	4 38 0	9. 75587	14	10. 24413	9. 84119	20	10. 15881	10. 08531	7	9. 91469	15
46	21 52	38 8	75605	14	24395	84146	21	15854	08540	7	91460	14
47	21 44	38 16	75624	14	24376	84173	21	15827	08549	7	91451	13
48	21 36	38 24	75642	15	24358	84200	22	15800	08558	7	91442	12
49	21 28	38 32	75660	15	24340	84227	22	15773	08567	7	91433	11
50	7 21 20	4 38 40	9. 75678	15	10. 24322	9. 84254	23	10. 15746	10. 08575	7	9. 91425	10
51	21 12	38 48	75696	16	24304	84280	23	15720	08584	7	91416	9
52	21 4	38 56	75714	16	24286	84307	23	15693	08593	8	91407	8
53	20 56	39 4	75733	16	24267	84334	24	15666	08602	8	91398	7
54	20 48	39 12	75751	17	24249	84361	24	15639	08611	8	91389	6
55	7 20 40	4 39 20	9. 75769	17	10. 24231	9. 84388	25	10. 15612	10. 08619	8	9. 91381	5
56	20 32	39 28	75787	17	24213	84415	25	15585	08628	8	91372	4
57	20 24	39 36	75805	17	24195	84442	26	15558	08637	8	91363	3
58	20 16	39 44	75823	18	24177	84469	26	15531	08646	8	91354	2
59	20 8	39 52	75841	18	24159	84496	27	15504	08655	9	91345	1
60	20 0	40 0	75859	18	24141	84523	27	15477	08664	9	91336	0
M.	Hour P. M.	Hour A. M.	Cosine.	Diff.	Secant.	Cotangent.	Diff.	Tangent.	Cosecant.	Diff.	Sine.	M.

124° 55°

SINES, TANGENTS, AND SECANTS.

35°												114°
M.	Hour A. M.	Hour P. M.	Sine	Diff.	Cosecant.	Tangent	Diff.	Cotangent.	Secant.	Diff.	Cosine.	M.
0	7 20 0	4 40 0	9. 75859	0	10. 24141	9. 84523	0	10. 15477	10. 08664	0	9. 91336	60
1	19 52	40 8	75877	0	24123	84550	0	15450	08672	0	91328	59
2	19 44	40 16	75895	1	24105	84576	1	15424	08681	0	91319	58
3	19 36	40 24	75913	1	24087	84603	1	15397	08690	0	91310	57
4	19 28	40 32	75931	1	24069	84630	2	15370	08699	1	91301	56
5	7 19 20	4 40 40	9. 75949	1	10. 24051	9. 84657	2	10. 15343	10. 08708	1	9. 91292	55
6	19 12	40 48	75967	2	24033	84684	3	15316	08717	1	91283	54
7	19 4	40 56	75985	2	24015	84711	3	15289	08726	1	91274	53
8	18 56	41 4	76003	2	23997	84738	4	15262	08734	1	91266	52
9	18 48	41 12	76021	3	23979	84764	4	15236	08743	1	91257	51
10	7 18 40	4 41 20	9. 76039	3	10. 23961	9. 84791	4	10. 15209	10. 08752	2	9. 91248	50
11	18 32	41 28	76057	3	23943	84818	5	15182	08761	2	91239	49
12	18 24	41 36	76075	4	23925	84845	5	15155	08770	2	91230	48
13	18 16	41 44	76093	4	23907	84872	6	15128	08779	2	91221	47
14	18 8	41 52	76111	4	23889	84899	6	15101	08788	2	91212	46
15	7 18 0	4 42 0	9. 76129	4	10. 23871	9. 84925	7	10. 15075	10. 08797	2	9. 91203	45
16	17 52	42 8	76146	5	23854	84952	7	15048	08806	2	91194	44
17	17 44	42 16	76164	5	23836	84979	8	15021	08815	3	91185	43
18	17 36	42 24	76182	5	23818	85006	8	14994	08824	3	91176	42
19	17 28	42 32	76200	6	23800	85033	8	14967	08833	3	91167	41
20	7 17 20	4 42 40	9. 76218	6	10. 23782	9. 85059	9	10. 14941	10. 08842	3	9. 91158	40
21	17 12	42 48	76236	6	23764	85086	9	14914	08851	3	91149	39
22	17 4	42 56	76253	6	23747	85113	10	14887	08859	3	91141	38
23	16 56	43 4	76271	7	23729	85140	10	14860	08868	3	91132	37
24	16 48	43 12	76289	7	23711	85166	11	14834	08877	4	91123	36
25	7 16 40	4 43 20	9. 76307	7	10. 23693	9. 85193	11	10. 14807	10. 08886	4	9. 91114	35
26	16 32	43 28	76324	8	23676	85220	12	14780	08895	4	91105	34
27	16 24	43 36	76342	8	23658	85247	12	14753	08904	4	91096	33
28	16 16	43 44	76360	8	23640	85273	13	14727	08913	4	91087	32
29	16 8	43 52	76378	9	23622	85300	13	14700	08922	4	91078	31
30	7 16 0	4 44 0	9. 76395	9	10. 23605	9. 85327	13	10. 14673	10. 08931	5	9. 91069	30
31	15 52	44 8	76413	9	23587	85354	14	14646	08940	5	91060	29
32	15 44	44 16	76431	9	23569	85380	14	14620	08949	5	91051	28
33	15 36	44 24	76448	10	23552	85407	15	14593	08958	5	91042	27
34	15 28	44 32	76466	10	23534	85434	15	14566	08967	5	91033	26
35	7 15 20	4 44 40	9. 76484	10	10. 23516	9. 85460	16	10. 14540	10. 08977	5	9. 91023	25
36	15 12	44 48	76501	11	23499	85487	16	14513	08986	5	91014	24
37	15 4	44 56	76519	11	23481	85514	16	14486	08995	6	91005	23
38	14 56	45 4	76537	11	23463	85540	17	14460	09004	6	90996	22
39	14 48	45 12	76554	12	23446	85567	17	14433	09013	6	90987	21
40	7 14 40	4 45 20	9. 76572	12	10. 23428	9. 85594	18	10. 14406	10. 09022	6	9. 90978	20
41	14 32	45 28	76590	12	23410	85620	18	14380	09031	6	90969	19
42	14 24	45 36	76607	12	23393	85647	19	14353	09040	6	90960	18
43	14 16	45 44	76625	13	23375	85674	19	14326	09049	6	90951	17
44	14 8	45 52	76642	13	23358	85700	20	14300	09058	7	90942	16
45	7 14 0	4 46 0	9. 76660	13	10. 23340	9. 85727	20	10. 14273	10. 09067	7	9. 90933	15
46	13 52	46 8	76677	14	23323	85754	20	14246	09076	7	90924	14
47	13 44	46 16	76695	14	23305	85780	21	14220	09085	7	90915	13
48	13 36	46 24	76712	14	23288	85807	21	14193	09094	7	90906	12
49	13 28	46 32	76730	14	23270	85834	22	14166	09104	7	90896	11
50	7 13 20	4 46 40	9. 76747	15	10. 23253	9. 85860	22	10. 14140	10. 09113	8	9. 90887	10
51	13 12	46 48	76765	15	23235	85887	23	14113	00122	8	90878	9
52	13 4	46 56	76782	15	23218	85913	23	14087	09131	8	90869	8
53	12 56	47 4	76800	16	23200	85940	24	14060	09140	8	90860	7
54	12 48	47 12	76817	16	23183	85967	24	14033	09149	8	90851	6
55	7 12 40	4 47 20	9. 76835	16	10. 23165	9. 85993	24	10. 14007	10. 09158	8	9. 90842	5
56	12 32	47 28	76852	17	23148	86020	25	13980	09168	8	90832	4
57	12 24	47 36	76870	17	23130	86046	25	13954	09177	9	90823	3
58	12 16	47 44	76887	17	23113	86073	26	13927	09186	9	90814	2
59	12 8	47 52	76904	17	23096	86100	26	13900	09195	9	90805	1
60	12 0	48 0	76922	18	23078	86126	27	13874	09204	9	90796	0
M.	Hour P. M.	Hour A. M.	Cosine.	Diff.	Secant.	Cotangent.	Diff.	Tangent.	Cosecant.	Diff.	Sine	M.
125°												54°

SINES, TANGENTS, AND SECANTS.

36°													143°
M.	Hour A. M.	Hour P. M.	Sine.	Diff.	Cosecant.	Tangent.	Diff.	Cotangent.	Secant.	Diff.	Cosine.	M.
0	7 12 0	4 48 0	9. 76922	0	10. 23078	9. 86126	0	10. 13874	10. 09204	0	9. 90796	60
1	11 52	48 8	76939	0	23061	86153	0	13847	09213	0	90787	59
2	11 44	48 16	76957	1	23043	86179	1	13821	09223	0	90777	58
3	11 36	48 24	76974	1	23026	86205	1	13794	09232	0	90767	57
4	11 28	48 32	76991	1	23009	86232	2	13768	09241	1	90759	56
5	7 11 20	4 48 40	9. 77009	1	10. 22991	9. 86259	2	10. 13741	10. 09250	1	9. 90750	55
6	11 12	48 48	77026	2	22974	86285	3	13715	09259	1	90741	54
7	11 4	48 56	77043	2	22957	86312	3	13688	09269	1	90731	53
8	10 56	49 4	77061	2	22939	86338	4	13662	09278	1	90722	52
9	10 48	49 12	77078	3	22922	86365	4	13635	09287	1	90713	51
10	7 10 40	4 49 20	9. 77095	3	10. 22905	9. 86392	4	10. 13608	10. 09296	2	9. 90704	50
11	10 32	49 28	77112	3	22888	86418	5	13582	09306	2	90694	49
12	10 24	49 36	77130	3	22870	86445	5	13555	09315	2	90685	48
13	10 16	49 44	77147	4	22853	86471	6	13529	09324	2	90676	47
14	10 8	49 52	77164	4	22836	86498	6	13502	09333	2	90667	46
15	7 10 0	4 50 0	9. 77181	4	10. 22819	9. 86524	7	10. 13476	10. 09343	2	9. 90657	45
16	9 52	50 8	77199	5	22801	86551	7	13449	09352	2	90648	44
17	9 44	50 16	77216	5	22784	86577	7	13423	09361	3	90639	43
18	9 36	50 24	77233	5	22767	86603	8	13397	09370	3	90630	42
19	9 28	50 32	77250	5	22750	86630	8	13370	09380	3	90620	41
20	7 9 20	4 50 40	9. 77268	6	10. 22732	9. 86656	9	10. 13344	10. 09389	3	9. 90611	40
21	9 12	50 48	77285	6	22715	86683	9	13317	09398	3	90602	39
22	9 4	50 56	77302	6	22698	86709	10	13291	09408	3	90592	38
23	8 56	51 4	77319	7	22681	86736	10	13264	09417	4	90583	37
24	8 48	51 12	77336	7	22664	86762	11	13238	09426	4	90574	36
25	7 8 40	4 51 20	9. 77353	7	10. 22647	9. 86789	11	10. 13211	10. 09435	4	9. 90565	35
26	8 32	51 28	77370	7	22630	86815	11	13185	09445	4	90555	34
27	8 24	51 36	77387	8	22613	86842	12	13158	09454	4	90546	33
28	8 16	51 44	77405	8	22595	86868	12	13132	09463	4	90537	32
29	8 8	51 52	77422	8	22578	86894	13	13106	09473	5	90527	31
30	7 8 0	4 52 0	9. 77439	9	10. 22561	9. 86921	13	10. 13079	10. 09482	5	9. 90518	30
31	7 52	52 8	77456	9	22544	86947	14	13053	09491	5	90509	29
32	7 44	52 16	77473	9	22527	86974	14	13026	09501	5	90499	28
33	7 36	52 24	77490	9	22510	87000	15	13000	09510	5	90490	27
34	7 28	52 32	77507	10	22493	87027	15	12973	09520	5	90480	26
35	7 7 20	4 52 40	9. 77524	10	10. 22476	9. 87053	15	10. 12947	10. 09529	5	9. 90471	25
36	7 12	52 48	77541	10	22459	87079	16	12921	09538	6	90462	24
37	7 4	52 56	77558	11	22442	87106	16	12894	09548	6	90452	23
38	6 56	53 4	77575	11	22425	87132	17	12868	09557	6	90443	22
39	6 48	53 12	77592	11	22408	87158	17	12842	09566	6	90434	21
40	7 6 40	4 53 20	9. 77609	11	10. 22391	9. 87185	18	10. 12815	10. 09576	6	9. 90424	20
41	6 32	53 28	77626	12	22374	87211	18	12789	09585	6	90415	19
42	6 24	53 36	77643	12	22357	87238	18	12762	09595	7	90405	18
43	6 16	53 44	77660	12	22340	87264	19	12736	09604	7	90396	17
44	6 8	53 52	77677	13	22323	87290	19	12710	09614	7	90386	16
45	7 6 0	4 54 0	9. 77694	13	10. 22306	9. 87317	20	10. 12683	10. 09623	7	9. 90377	15
46	5 52	54 8	77711	13	22289	87343	20	12657	09632	7	90368	14
47	5 44	54 16	77728	13	22272	87369	21	12631	09642	7	90358	13
48	5 36	54 24	77744	14	22256	87396	21	12604	09651	7	90349	12
49	5 28	54 32	77761	14	22239	87422	22	12578	09661	8	90339	11
50	7 5 20	4 54 40	9. 77778	14	10. 22222	9. 87448	22	10. 12552	10. 09670	8	9. 90330	10
51	5 12	54 48	77795	15	22205	87475	22	12525	09680	8	90320	9
52	5 4	54 56	77812	15	22188	87501	23	12499	09689	8	90311	8
53	4 56	55 4	77829	15	22171	87527	23	12473	09699	8	90301	7
54	4 48	55 12	77846	15	22154	87554	24	12446	09708	8	90292	6
55	7 4 40	4 55 20	9. 77862	16	10. 22138	9. 87580	24	10. 12420	10. 09718	9	9. 90282	5
56	4 32	55 28	77879	16	22121	87606	25	12394	09727	9	90273	4
57	4 24	55 36	77896	16	22104	87633	25	12367	09737	9	90263	3
58	4 16	55 44	77913	16	22087	87659	26	12341	09746	9	90254	2
59	4 8	55 52	77930	17	22070	87685	26	12315	09756	9	90244	1
60	4 0	56 0	77946	17	22054	87711	26	12289	09765	9	90235	0
M.	Hour P. M.	Hour A. M.	Cosine.	Diff.	Secant.	Cotangent.	Diff.	Tangent.	Cosecant.	Diff.	Sine.	M.
126°												53°

SINES, TANGENTS, AND SECANTS.

37°												142°
M.	Hour A. M.	Hour P. M.	Sine.	Diff.	Cosecant.	Tangent.	Diff.	Cotangent.	Secant.	Diff.	Cosine.	M.
0	7 4 0	4 56 0	9. 77946	0	10. 22054	9. 87711	0	10. 12289	10. 09765	0	9. 90235	60
1	3 52	56 8	77963	0	22037	87738	0	12262	09775	0	90225	59
2	3 44	56 16	77980	1	22020	87764	1	12236	09784	0	90216	58
3	3 36	56 24	77997	1	22003	87790	1	12210	09794	0	90206	57
4	3 28	56 32	78013	1	21987	87817	2	12183	09803	1	90197	56
5	7 3 20	4 56 40	9. 78030	1	10. 21970	9. 87843	2	10. 12157	10. 09813	1	9. 90187	55
6	3 12	56 48	78047	2	21953	87869	3	12131	09822	1	90178	54
7	3 4	56 56	78063	2	21937	87895	3	12105	09832	1	90168	53
8	2 56	57 4	78080	2	21920	87922	3	12078	09841	1	90159	52
9	2 48	57 12	78097	2	21903	87948	4	12052	09851	1	90149	51
10	7 2 40	4 57 20	9. 78113	3	10. 21887	9. 87974	4	10. 12026	10. 09861	2	9. 90139	50
11	2 32	57 28	78130	3	21870	88000	5	12000	09870	2	90130	49
12	2 24	57 36	78147	3	21853	88027	5	11973	09880	2	90120	48
13	2 16	57 44	78163	4	21837	88053	6	11947	09889	2	90111	47
14	2 8	57 52	78180	4	21820	88079	6	11921	09899	2	90101	46
15	7 2 0	4 58 0	9. 78197	4	10. 21803	9. 88105	7	10. 11895	10. 09909	2	9. 90091	45
16	1 52	58 8	78213	4	21787	88131	7	11869	09918	3	90082	44
17	1 44	58 16	78230	5	21770	88158	7	11842	09928	3	90072	43
18	1 30	58 24	78246	5	21754	88184	8	11816	09937	3	90063	42
19	1 28	58 32	78263	5	21737	88210	8	11790	09947	3	90053	41
20	7 1 20	4 58 40	9. 78280	5	10. 21720	9. 88236	9	10. 11764	10. 09957	3	9. 90043	40
21	1 12	58 48	78296	6	21704	88262	9	11738	09966	3	90034	39
22	1 4	58 56	78313	6	21687	88289	10	11711	09976	4	90024	38
23	0 56	59 4	78329	6	21671	88315	10	11685	09986	4	90014	37
24	0 48	59 12	78346	7	21654	88341	10	11659	09995	4	90005	36
25	7 0 40	4 59 20	9. 78362	7	10. 21638	9. 88367	11	10. 11633	10. 10005	4	9. 89995	35
26	0 32	59 28	78379	7	21621	88393	11	11607	10015	4	89985	34
27	0 24	59 36	78395	7	21605	88420	12	11580	10024	4	89976	33
28	0 16	59 44	78412	8	21588	88446	12	11554	10034	5	89966	32
29	0 8	59 52	78428	8	21572	88472	13	11528	10044	5	89956	31
30	7 0 0	5 0 0	9. 78445	8	10. 21555	9. 88498	13	10. 11502	10. 10053	5	9. 89947	30
31	6 59 52	0 8	78461	9	21539	88524	14	11476	10063	5	89937	29
32	59 44	0 16	78478	9	21522	88550	14	11450	10073	5	89927	28
33	59 36	0 24	78494	9	21506	88577	14	11423	10082	5	89918	27
34	59 28	0 32	78510	9	21490	88603	15	11397	10092	5	89908	26
35	6 59 20	5 0 40	9. 78527	10	10. 21473	9. 88629	15	10. 11371	10. 10102	6	9. 89898	25
36	59 12	0 48	78543	10	21457	88655	16	11345	10112	6	89888	24
37	59 4	0 56	78560	10	21440	88681	16	11319	10121	6	89879	23
38	58 56	1 4	78576	10	21424	88707	17	11293	10131	6	89869	22
39	58 48	1 12	78592	11	21408	88733	17	11267	10141	6	89859	21
40	6 58 40	5 1 20	9. 78609	11	10. 21391	9. 88759	17	10. 11241	10. 10151	6	9. 89849	20
41	58 32	1 28	78625	11	21375	88786	18	11214	10160	7	89840	19
42	58 24	1 36	78642	12	21358	88812	18	11188	10170	7	89830	18
43	58 16	1 44	78658	12	21342	88838	19	11162	10180	7	89820	17
44	58 8	1 52	78674	13	21326	88864	19	11136	10190	7	89810	16
45	6 58 0	5 2 0	9. 78691	12	10. 21309	9. 88890	20	10. 11110	10. 10199	7	9. 89801	15
46	57 52	2 8	78707	13	21293	88916	20	11084	10209	7	89791	14
47	57 44	2 16	78723	13	21277	88942	20	11058	10219	8	89781	13
48	57 36	2 24	78739	13	21261	88968	21	11032	10229	8	89771	12
49	57 28	2 32	78756	13	21244	88994	21	11006	10239	8	89761	11
50	6 57 20	5 2 40	9. 78772	14	10. 21228	9. 89020	22	10. 10980	10. 10248	8	9. 89752	10
51	57 12	2 48	78788	14	21212	89046	22	10954	10258	8	89742	9
52	57 4	2 56	78805	14	21195	89073	23	10927	10268	8	89732	8
53	56 56	3 4	78821	15	21179	89099	23	10901	10278	9	89722	7
54	56 48	3 12	78837	15	21163	89125	24	10875	10288	9	89712	6
55	6 56 40	5 3 20	9. 78853	15	10. 21147	9. 89151	24	10. 10849	10. 10298	9	9. 89702	5
56	56 32	3 28	78869	15	21131	89177	24	10823	10307	9	89693	4
57	56 24	3 36	78886	16	21114	89203	25	10797	10317	9	89683	3
58	56 16	3 44	78902	16	21098	89229	25	10771	10327	9	89673	2
59	56 8	3 52	78918	16	21082	89255	26	10745	10337	10	89663	1
60	56 0	4 0	78934	16	21066	89281	26	10719	10347	10	89653	0
M.	Hour P. M.	Hour A. M.	Cosine.	Diff.	Secant.	Cotangent.	Diff.	Tangent.	Cosecant.	Diff.	Sine.	M.
127°												52°

SINES, TANGENTS, AND SECANTS.

38°

M.	Hour A. M.	Hour P. M.	Sine.	Diff.	Cosecant.	Tangent.	Diff.	Cotangent.	Secant.	Diff.	Cosine.	M.
0	6 56 0	5 4 0	9. 78934	0	10. 21066	9 89281	0	10. 10719	10. 10347	0	9. 89653	6
1	55 52	4 8	78950	0	21050	89307	0	10693	10357	0	89643	5
2	55 44	4 16	78967	1	21033	89333	1	10667	10367	0	89633	5
3	55 36	4 24	78983	1	21017	89359	1	10641	10376	1	89624	5
4	55 28	4 32	78999	1	21001	89385	2	10615	10386	1	89614	5
5	6 55 20	5 4 40	9. 79015	1	10. 20985	9 89411	2	10. 10589	10. 10396	1	9. 89604	5
6	55 12	4 48	79031	2	20969	89437	3	10563	10406	1	89594	5
7	55 4	4 56	79047	2	20953	89463	3	10537	10416	1	89584	5
8	54 56	5 4	79063	2	20937	89489	3	10511	10426	1	89574	5
9	54 48	5 12	79079	2	20921	89515	4	10485	10436	2	89564	5
10	6 54 40	5 5 20	9. 79095	3	10. 20905	9. 89541	4	10. 10459	10. 10446	2	9. 89554	5
11	54 32	5 28	79111	3	20889	89567	5	10433	10456	2	89544	4
12	54 24	5 36	79128	3	20872	89593	5	10407	10466	2	89534	4
13	54 16	5 44	79144	3	20856	89619	6	10381	10476	2	89524	4
14	54 8	5 52	79160	4	20840	89645	6	10355	10486	2	89514	4
15	6 54 0	5 6 0	9. 79176	4	10. 20824	9. 89671	6	10. 10329	10. 10496	3	9. 89504	4
16	53 52	6 8	79192	4	20808	89697	7	10303	10505	3	89495	4
17	53 44	6 16	79208	5	20792	89723	7	10277	10515	3	89485	4
18	53 36	6 24	79224	5	20776	89749	8	10251	10525	3	89475	4
19	53 28	6 32	79240	5	20760	89775	8	10225	10535	3	89465	4
20	6 53 20	5 6 40	9. 79256	5	10. 20744	9. 89801	9	10. 10199	10. 10545	3	9. 89455	4
21	53 12	6 48	79272	6	20728	89827	9	10173	10555	4	89445	3
22	53 4	6 56	79288	6	20712	89853	10	10147	10565	4	89435	3
23	52 56	7 4	79304	6	20696	89879	10	10121	10575	4	89425	3
24	52 48	7 12	79319	6	20681	89905	10	10095	10585	4	89415	3
25	6 52 40	5 7 20	9. 79335	7	10. 20665	9. 89931	11	10. 10069	10. 10595	4	9. 89405	3
26	52 32	7 28	79351	7	20649	89957	11	10043	10605	4	89395	3
27	52 24	7 36	79367	7	20633	89983	12	10017	10615	5	89385	3
28	52 16	7 44	79383	7	20617	90009	12	09991	10625	5	89375	3
29	52 8	7 52	79399	8	20601	90035	13	09965	10636	5	89364	3
30	6 52 0	5 8 0	9. 79415	8	10. 20585	9. 90061	13	10. 09939	10. 10646	5	9. 89354	3
31	51 52	8 8	79431	8	20569	90086	13	09914	10656	5	89344	2
32	51 44	8 16	79447	8	20553	90112	14	09888	10666	5	89334	2
33	51 36	8 24	79463	9	20537	90138	14	09862	10676	6	89324	2
34	51 28	8 32	79478	9	20522	90164	15	09836	10686	6	89314	2
35	6 51 20	5 8 40	9. 79494	9	10. 20506	9. 90190	15	10. 09810	10. 10696	6	9. 89304	2
36	51 12	8 48	79510	10	20490	90216	16	09784	10706	6	89294	2
37	51 4	8 56	79526	10	20474	90242	16	09758	10716	6	89284	2
38	50 56	9 4	79542	10	20458	90268	16	09732	10726	6	89274	2
39	50 48	9 12	79558	10	20442	90294	17	09706	10736	7	89264	2
40	6 50 40	5 9 20	9. 79573	11	10. 20427	9. 90320	17	10. 09680	10. 10746	7	9. 89254	2
41	50 32	9 28	79589	11	20411	90346	18	09654	10756	7	89244	1
42	50 24	9 36	79605	11	20395	90371	18	09629	10767	7	89233	1
43	50 16	9 44	79621	11	20379	90397	19	09603	10777	7	89223	1
44	50 8	9 52	79636	12	20364	90423	19	09577	10787	7	89213	1
45	6 50 0	5 10 0	9. 79652	12	10. 20348	9. 90449	19	10. 09551	10. 10797	8	9. 89203	1
46	49 52	10 8	79668	12	20332	90475	20	09525	10807	8	89193	1
47	49 44	10 16	79684	12	20316	90501	20	09499	10817	8	89183	1
48	49 36	10 24	79699	13	20301	90527	21	09473	10827	8	89173	1
49	49 28	10 32	79715	13	20285	90553	21	09447	10838	8	89162	1
50	6 49 20	5 10 40	9. 79731	13	10. 20269	9. 90578	22	10. 09422	10. 10848	8	9. 89152	1
51	49 12	10 48	79746	14	20254	90604	22	09396	10858	9	89142	1
52	49 4	10 56	79762	14	20238	90630	22	09370	10868	9	89132	1
53	48 56	11 4	79778	14	20222	90656	23	09344	10878	9	89122	1
54	48 48	11 12	79793	14	20207	90682	23	09318	10888	9	89112	1
55	6 48 40	5 11 20	9. 79809	15	10. 20191	9. 90708	24	10. 09292	10. 10899	9	9. 89101	1
56	48 32	11 28	79825	15	20175	90734	24	09266	10909	9	89091	1
57	48 24	11 36	79840	15	20160	90759	25	09241	10919	10	89081	1
58	48 16	11 44	79856	15	20144	90785	25	09215	10929	10	89071	1
59	48 8	11 52	79872	16	20128	90811	26	09189	10940	10	89060	1
60	48 0	12 0	79887	16	20113	90837	26	09163	10950	10	89050	0
M.	Hour P. M.	Hour A. M.	Cosine.	Diff.	Secant.	Cotangent.	Diff.	Tangent.	Cosecant.	Diff.	Sine.	M.

128°

SINES, TANGENTS, AND SECANTS.

39°												110°
M.	Hour A.M.	Hour P.M.	Sine.	Diff.	Cosecant.	Tangent.	Diff.	Cotangent.	Secant.	Diff.	Cosine	M.
0	6 48 0	5 12 0	9. 79887	0	10. 20113	9. 90837	0	10. 09163	10. 10950	0	9. 89050	60
1	47 52	12 8	79903	0	20097	90863	0	09137	10950	0	89040	59
2	47 44	12 16	79918	1	20082	90889	1	09111	10970	0	89030	58
3	47 36	12 24	79934	1	20066	90914	1	09086	10980	1	89020	57
4	47 28	12 32	79950	1	20050	90940	2	09060	10991	1	89009	56
5	6 47 20	5 12 40	9. 79965	1	10. 20035	9. 90966	2	10. 09034	10. 11001	1	9. 88999	55
6	47 12	12 48	79981	2	20019	90992	3	09008	11011	1	88989	54
7	47 4	12 56	79996	2	20004	91018	3	08982	11022	1	88978	53
8	46 56	13 4	80012	2	19988	91043	3	08957	11032	1	88968	52
9	46 48	13 12	80027	2	19973	91069	4	08931	11042	2	88958	51
10	6 46 40	5 13 20	9. 80043	3	10. 19957	9. 91095	4	10. 08905	10. 11052	2	9. 88948	50
11	46 32	13 28	80058	3	19942	91121	5	08879	11063	2	88937	49
12	46 24	13 36	80074	3	19926	91147	5	08853	11073	2	88927	48
13	46 16	13 44	80089	3	19911	91172	6	08828	11083	2	88917	47
14	46 8	13 52	80105	4	19895	91198	6	08802	11094	2	88906	46
15	6 46 0	5 14 0	9. 80120	4	10. 19880	9. 91224	6	10. 08776	10. 11104	3	9. 88896	45
16	45 52	14 8	80136	4	19864	91250	7	08750	11114	3	88886	44
17	45 44	14 16	80151	4	19849	91276	7	08724	11125	3	88875	43
18	45 36	14 24	80166	5	19834	91301	8	08699	11135	3	88865	42
19	45 28	14 32	80182	5	19818	91327	8	08673	11145	3	88855	41
20	6 45 20	5 14 40	9. 80197	5	10. 19803	9. 91353	9	10. 08647	10. 11156	3	9. 88844	40
21	45 12	14 48	80213	5	19787	91379	9	08621	11166	4	88834	39
22	45 4	14 56	80228	6	19772	91404	9	08596	11176	4	88824	38
23	44 56	15 4	80244	6	19756	91430	10	08570	11187	4	88813	37
24	44 48	15 12	80259	6	19741	91456	10	08544	11197	4	88803	36
25	6 44 40	5 15 20	9. 80274	6	10. 19726	9. 91482	11	10. 08518	10. 11207	4	9. 88793	35
26	44 32	15 28	80290	7	19710	91507	11	08493	11218	5	88782	34
27	44 24	15 36	80305	7	19695	91533	12	08467	11228	5	88772	33
28	44 16	15 44	80320	7	19680	91559	12	08441	11239	5	88761	32
29	44 8	15 52	80336	7	19664	91585	12	08415	11249	5	88751	31
30	6 44 0	5 16 0	9. 80351	8	10. 19649	9. 91610	13	10. 08390	10. 11259	5	9. 88741	30
31	43 52	16 8	80366	8	19634	91636	13	08364	11270	5	88730	29
32	43 44	16 16	80382	8	19618	91662	14	08338	11280	6	88720	28
33	43 36	16 24	80397	8	19603	91688	14	08312	11291	6	88709	27
34	43 28	16 32	80412	9	19588	91713	15	08287	11301	6	88699	26
35	6 43 20	5 16 40	9. 80428	9	10. 19572	9. 91739	15	10. 08261	10. 11312	6	9. 88688	25
36	43 12	16 48	80443	9	19557	91765	15	08235	11322	6	88678	24
37	43 4	16 56	80458	9	19542	91791	16	08209	11332	6	88668	23
38	42 56	17 4	80473	10	19527	91816	16	08184	11343	7	88657	22
39	42 48	17 12	80489	10	19511	91842	17	08158	11353	7	88647	21
40	6 42 40	5 17 20	9. 80504	10	10. 19496	9. 91868	17	10. 08132	10. 11364	7	9. 88636	20
41	42 32	17 28	80519	10	19481	91893	18	08107	11374	7	88626	19
42	42 24	17 36	80534	11	19466	91919	18	08081	11385	7	88615	18
43	42 16	17 44	80550	11	19450	91945	18	08055	11395	7	88605	17
44	42 8	17 52	80565	11	19435	91971	19	08029	11406	8	88594	16
45	6 42 0	5 18 0	9. 80580	12	10. 19420	9. 91996	19	10. 08004	10. 11416	8	9. 88584	15
46	42 52	18 8	80595	12	19405	92022	20	07978	11427	8	88573	14
47	41 44	18 16	80610	12	19390	92048	20	07952	11437	8	88563	13
48	41 36	18 24	80625	12	19375	92073	21	07927	11448	8	88552	12
49	41 28	18 32	80641	13	19359	92099	21	07901	11458	9	88542	11
50	6 41 20	5 18 40	9. 80656	13	10. 19344	9. 92125	21	10. 07875	10. 11469	9	9. 88531	10
51	41 12	18 48	80671	13	19329	92150	22	07850	11479	9	88521	9
52	41 4	18 56	80686	13	19314	92176	22	07824	11490	9	88510	8
53	40 56	19 4	80701	14	19299	92202	23	07798	11501	9	88499	7
54	40 48	19 12	80716	14	19284	92227	23	07773	11511	9	88489	6
55	6 40 40	5 19 20	9. 80731	14	10. 19269	9. 92253	24	10. 07747	10. 11522	10	9. 88478	5
56	40 32	19 28	80746	14	19254	92279	24	07721	11532	10	88468	4
57	40 24	19 36	80762	15	19238	92304	24	07696	11543	10	88457	3
58	40 16	19 44	80777	15	19223	92330	25	07670	11553	10	88447	2
59	40 8	19 52	80792	15	19208	92356	25	07644	11564	10	88436	1
60	40 0	20 0	80807	15	19193	92381	26	07619	11575	10	88425	0
M.	Hour P.M.	Hour A.M.	Cosine	Diff.	Secant.	Cotangent.	Diff.	Tangent.	Cosecant.	Diff.	Sine.	M.
129°												50°

SINES, TANGENTS, AND SECANTS.

40° 139°

M.	Hour A. M.	Hour P. M.	Sine.	Diff.	Cosecant.	Tangent.	Diff.	Cotangent.	Secant.	Diff.	Cosine.	M
0	6 40 0	5 20 0	9. 80807	0	10. 19193	9. 92381	0	10. 07619	10. 11575	0	9. 88425	60
1	39 52	20 8	80822	0	19178	92407	0	07593	11585	0	88415	59
2	39 44	20 16	80837	0	19163	92433	1	07567	11596	0	88404	58
3	39 36	20 24	80852	1	19148	92458	1	07542	11606	1	88394	57
4	39 28	20 32	80867	1	19133	92484	2	07516	11617	1	88383	56
5	6 39 20	5 20 40	9. 80882	1	10. 19118	9. 92510	2	10. 07490	10. 11628	1	9. 88372	55
6	39 12	20 48	80897	1	19103	92535	3	07465	11638	1	88362	54
7	39 4	20 56	80912	2	19088	92561	3	07439	11649	1	88351	53
8	38 56	21 4	80927	2	19073	92587	3	07413	11660	1	88340	52
9	38 48	21 12	80942	2	19058	92612	4	07388	11670	2	88330	51
10	6 38 40	5 21 20	9. 80957	2	10. 19043	9. 92638	4	10. 07362	10. 11681	2	9. 88319	50
11	38 32	21 28	80972	3	19028	92663	5	07337	11692	2	88308	49
12	38 24	21 36	80987	3	19013	92689	5	07311	11702	2	88298	48
13	38 16	21 44	81002	3	18998	92715	6	07285	11713	2	88287	47
14	38 8	21 52	81017	3	18983	92740	6	07260	11724	3	88276	46
15	6 38 0	5 22 0	9. 81032	4	10. 18968	9. 92766	6	10. 07234	10. 11734	3	9. 88266	45
16	37 52	22 8	81047	4	18953	92792	7	07208	11745	3	88255	44
17	37 44	22 16	81061	4	18939	92817	7	07183	11756	3	88244	43
18	37 36	22 24	81076	4	18924	92843	8	07157	11766	3	88234	42
19	37 28	22 32	81091	5	18909	92868	8	07132	11777	3	88223	41
20	6 37 20	5 22 40	9. 81106	5	10. 18894	9. 92894	9	10. 07106	10. 11788	4	9. 88212	40
21	37 12	22 48	81121	5	18879	92920	9	07080	11799	4	88201	39
22	37 4	22 56	81136	5	18864	92945	9	07055	11809	4	88191	38
23	36 56	23 4	81151	6	18849	92971	10	07029	11820	4	88180	37
24	36 48	23 12	81166	6	18834	92996	10	07004	11831	4	88169	36
25	6 36 40	5 23 20	9. 81180	6	10. 18820	9. 93022	11	10. 06978	10. 11842	4	9. 88158	35
26	36 32	23 28	81195	6	18805	93048	11	06952	11852	5	88148	34
27	36 24	23 36	81210	7	18790	93073	12	06927	11863	5	88137	33
28	36 16	23 44	81225	7	18775	93099	12	06901	11874	5	88126	32
29	36 8	23 52	81240	7	18760	93124	12	06876	11885	5	88115	31
30	6 36 0	5 24 0	9. 81254	7	10. 18746	9. 93150	13	10. 06850	10. 11895	5	9. 88105	30
31	35 52	24 8	81269	8	18731	93175	13	06825	11906	6	88094	29
32	35 44	24 16	81284	8	18716	93201	14	06799	11917	6	88083	28
33	35 36	24 24	81299	8	18701	93227	14	06773	11928	6	88072	27
34	35 28	24 32	81314	8	18686	93252	14	06748	11939	6	88061	26
35	6 35 20	5 24 40	9. 81328	9	10. 18672	9. 93278	15	10. 06722	10. 11949	6	9. 88051	25
36	35 12	24 48	81343	9	18657	93303	15	06697	11960	6	88040	24
37	35 4	24 56	81358	9	18642	93329	16	06671	11971	7	88029	23
38	34 56	25 4	81372	9	18628	93354	16	06646	11982	7	88018	22
39	34 48	25 12	81387	10	18613	93380	17	06620	11993	7	88007	21
40	6 34 40	5 25 20	9. 81402	10	10. 18598	9. 93406	17	10. 06594	10. 12004	7	9. 87996	20
41	34 32	25 28	81417	10	18583	93431	17	06569	12015	7	87985	19
42	34 24	25 36	81431	10	18569	93457	18	06543	12025	8	87975	18
43	34 16	25 44	81446	11	18554	93482	18	06518	12036	8	87964	17
44	34 8	25 52	81461	11	18539	93508	19	06492	12047	8	87953	16
45	6 34 0	5 26 0	9. 81475	11	10. 18525	9. 93533	19	10. 06467	10. 12058	8	9. 87942	15
46	33 52	26 8	81490	11	18510	93559	20	06441	12069	8	87931	14
47	33 44	26 16	81505	12	18495	93584	20	06416	12080	8	87920	13
48	33 36	26 24	81519	12	18481	93610	20	06390	12091	9	87909	12
49	33 28	26 32	81534	12	18466	93636	21	06364	12102	9	87898	11
50	6 33 20	6 26 40	9. 81549	12	10. 18451	9. 93661	21	10. 06339	10. 12113	9	9. 87887	10
51	33 12	26 48	81563	13	18437	93687	22	06313	12123	9	87877	9
52	33 4	26 56	81578	13	18422	93712	22	06288	12134	9	87866	8
53	32 56	27 4	81592	13	18408	93738	23	06262	12145	10	87855	7
54	32 48	27 12	81607	13	18393	93763	23	06237	12156	10	87844	6
55	6 32 40	5 27 20	9. 81622	14	10. 18378	9. 93789	23	10. 06211	10. 12167	10	9. 87833	5
56	32 32	27 28	81636	14	18364	93814	24	06186	12178	10	87822	4
57	32 24	27 36	81651	14	18349	93840	24	06160	12189	10	87811	3
58	32 16	27 44	81665	14	18335	93865	25	06135	12200	10	87800	2
59	32 8	27 52	81680	15	18320	93891	25	06109	12211	11	87789	1
60	32 0	28 0	81694	15	18306	93916	26	06084	12222	11	87778	0
M.	Hour P. M.	Hour A. M.	Cosine.	Diff.	Secant.	Cotangent	Diff.	Tangent.	Cosecant.	Diff.	Sine	M.

130° 49°

41° 128°

M.	Hour A. M.	Hour P. M.	Sine.	Diff.	Cosecant.	Tangent.	Diff.	Cotangent.	Secant.	Diff.	Cosine.	M.
0	6 32 0	5 28 0	9. 81694	0	10. 18306	9. 93916	0	10. 06084	10. 12222	0	9. 87778	60
1	31 52	28 8	81709	0	18291	93942	0	06058	12233	0	87767	59
2	31 44	28 16	81723	0	18277	93967	1	06033	12244	0	87756	58
3	31 36	28 24	81738	1	18262	93993	1	06007	12255	1	87745	57
4	31 28	28 32	81752	1	18248	94018	2	05982	12266	1	87734	56
5	6 31 20	5 28 40	9. 81767	1	10. 18233	9. 94044	2	10. 05956	10. 12277	1	9. 87723	55
6	31 12	28 48	81781	1	18219	94069	3	05931	12288	1	87712	54
7	31 4	28 56	81796	2	18204	94095	3	05905	12299	1	87701	53
8	30 56	29 4	81810	2	18190	94120	3	05880	12310	1	87690	52
9	30 48	29 12	81825	2	18175	94146	4	05854	12321	2	87679	51
10	6 30 40	5 29 20	9. 81839	2	10. 18161	9. 94171	4	10. 05829	10. 12332	2	9. 87668	50
11	30 32	29 28	81854	3	18146	94197	5	05803	12343	2	87657	49
12	30 24	29 36	81868	3	18132	94222	5	05778	12354	2	87646	48
13	30 16	29 44	81882	3	18118	94248	6	05752	12365	2	87635	47
14	30 8	29 52	81897	3	18103	94273	6	05727	12376	3	87624	46
15	6 30 0	5 30 0	9. 81911	4	10. 18089	9. 94299	6	10. 05701	10. 12387	3	9. 87613	45
16	29 52	30 8	81926	4	18074	94324	7	05676	12399	3	87601	44
17	29 44	30 16	81940	4	18060	94350	7	05650	12410	3	87590	43
18	29 36	30 24	81955	4	18045	94375	8	05625	12421	3	87579	42
19	29 28	30 32	81969	5	18031	94401	8	05599	12432	4	87568	41
20	6 29 20	5 30 40	9. 81983	5	10. 18017	9. 94426	8	10. 05574	10. 12443	4	9. 87557	40
21	29 12	30 48	81998	5	18002	94452	9	05548	12454	4	87546	39
22	29 4	30 56	82012	5	17988	94477	9	05523	12465	4	87535	38
23	28 56	31 4	82026	5	17974	94503	10	05497	12476	4	87524	37
24	28 48	31 12	82041	6	17959	94528	10	05472	12487	4	87513	36
25	6 28 40	5 31 20	9. 82055	6	10. 17945	9. 94554	11	10. 05446	10. 12499	5	9. 87501	35
26	28 32	31 28	82069	6	17931	94579	11	05421	12510	5	87490	34
27	28 24	31 36	82084	6	17916	94604	11	05396	12521	5	87479	33
28	28 16	31 44	82098	7	17902	94630	12	05370	12532	5	87468	32
29	28 8	31 52	82112	7	17888	94655	12	05345	12543	5	87457	31
30	6 28 0	5 32 0	9. 82126	7	10. 17874	9. 94681	13	10. 05319	10. 12554	6	9. 87446	30
31	27 52	32 8	82141	7	17859	94706	13	05294	12566	6	87434	29
32	27 44	32 16	82155	8	17845	94732	14	05268	12577	6	87423	28
33	27 36	32 24	82169	8	17831	94757	14	05243	12588	6	87412	27
34	27 28	32 32	82184	8	17816	94783	14	05217	12599	6	87401	26
35	6 27 20	5 32 40	9. 82198	8	10. 17802	9. 94808	15	10. 05192	10. 12610	7	9. 87390	25
36	27 12	32 48	82212	9	17788	94834	15	05166	12622	7	87378	24
37	27 4	32 56	82226	9	17774	94859	16	05141	12633	7	87367	23
38	26 56	33 4	82240	9	17760	94884	16	05116	12644	7	87356	22
39	26 48	33 12	82255	9	17745	94910	17	05090	12655	7	87345	21
40	6 26 40	5 33 20	9. 82269	10	10. 17731	9. 94935	17	10. 05065	10. 12666	7	9. 87334	20
41	26 32	33 28	82283	10	17717	94961	17	05039	12678	8	87322	19
42	26 24	33 36	82297	10	17703	94986	18	05014	12689	8	87311	18
43	26 16	33 44	82311	10	17689	95012	18	04988	12700	8	87300	17
44	26 8	33 52	82326	10	17674	95037	19	04963	12712	8	87288	16
45	6 26 0	5 34 0	9. 82340	11	10. 17660	9. 95062	19	10. 04938	10. 12723	8	9. 87277	15
46	25 52	34 8	82354	11	17646	95088	20	04912	12734	9	87266	14
47	25 44	34 16	82368	11	17632	95113	20	04887	12745	9	87255	13
48	25 36	34 24	82382	11	17618	95139	20	04861	12757	9	87243	12
49	25 28	34 32	82396	12	17604	95164	21	04836	12768	9	87232	11
50	6 25 20	5 34 40	9. 82410	12	10. 17590	9. 95190	21	10. 04810	10. 12779	9	9. 87221	10
51	25 12	34 48	82424	12	17576	95215	22	04785	12791	10	87209	9
52	25 4	34 56	82439	12	17561	95240	22	04760	12802	10	87198	8
53	24 56	35 4	82453	13	17547	95266	22	04734	12813	10	87187	7
54	24 48	35 12	82467	13	17533	95291	23	04709	12825	10	87175	6
55	6 24 40	5 35 20	9. 82481	13	10. 17519	9. 95317	23	10. 04683	10. 12836	10	9. 87164	5
56	24 32	35 28	82495	13	17505	95342	24	04658	12847	10	87153	4
57	24 24	35 36	82509	14	17491	95368	24	04632	12859	11	87141	3
58	24 16	35 44	82523	14	17477	95393	25	04607	12870	11	87130	2
59	24 8	35 52	82537	14	17463	95418	25	04582	12881	11	87119	1
60	24 0	36 0	82551	14	17449	95444	25	04556	12893	11	87107	0
M.	Hour P. M.	Hour A. M.	Cosine.	Diff.	Secant.	Cotangent.	Diff.	Tangent.	Cosecant.	Diff.	Sine.	M.

131° 48°

SINES, TANGENTS, AND SECANTS.

42°												1
M.	Hour A. M.	Hour P. M.	Sine.	Dif.	Cosecant.	Tangent.	Dif.	Cotangent.	Secant.	Dif.	Cosine.	
0	6 24 0	5 36 0	9. 82551	0	10. 17449	9. 95444	0	10. 04556	10. 12893	0	9. 87107	
1	23 52	36 8	82565	0	17435	95469	0	04531	12904	0	87096	
2	23 44	36 16	82579	0	17421	95495	1	04505	12915	0	87085	
3	23 36	36 24	82593	1	17407	95520	1	04480	12927	1	87073	
4	23 28	36 32	82607	1	17393	95545	2	04455	12938	1	87062	
5	6 23 20	5 36 40	9. 82621	1	10. 17379	9. 95571	2	10. 04429	10. 12950	1	9. 87050	
6	23 12	36 48	82635	1	17365	95596	3	04404	12961	1	87039	
7	23 4	36 56	82649	2	17351	95622	3	04378	12972	1	87028	
8	22 56	37 4	82663	2	17337	95647	3	04353	12984	2	87016	
9	22 48	37 12	82677	2	17323	95672	4	04328	12995	2	87005	
10	6 22 40	5 37 20	9. 82691	2	10. 17309	9. 95698	4	10. 04302	10. 13007	2	9. 86993	
11	22 32	37 28	82705	3	17295	95723	5	04277	13018	2	86982	
12	22 24	37 36	82719	3	17281	95748	5	04252	13030	2	86970	
13	22 16	37 44	82733	3	17267	95774	5	04226	13041	3	86959	
14	22 8	37 52	82747	3	17253	95799	6	04201	13053	3	86947	
15	6 22 0	5 38 0	9. 82761	3	10. 17239	9. 95825	6	10. 04175	10. 13064	3	9. 86936	
16	21 52	38 8	82775	4	17225	95850	7	04150	13076	3	86924	
17	21 44	38 16	82788	4	17212	95875	7	04125	13087	3	86913	
18	21 36	38 24	82802	4	17198	95901	8	04099	13098	3	86902	
19	21 28	38 32	82816	4	17184	95926	8	04074	13110	4	86890	
20	6 21 20	5 38 40	9. 82830	5	10. 17170	9. 95952	8	10. 04048	10. 13121	4	9. 86879	
21	21 12	38 48	82844	5	17156	95977	9	04023	13133	4	86867	
22	21 4	38 56	82858	5	17142	96002	9	03998	13145	4	86855	
23	20 56	39 4	82872	5	17128	96028	10	03972	13156	4	86844	
24	20 48	39 12	82885	6	17115	96053	10	03947	13168	5	86832	
25	6 20 40	5 39 20	9. 82899	6	10. 17101	9. 96078	11	10. 03922	10. 13179	5	9. 86821	
26	20 32	39 28	82913	6	17087	96104	11	03896	13191	5	86809	
27	20 24	39 36	82927	6	17073	96129	11	03871	13202	5	86798	
28	20 16	39 44	82941	6	17059	96155	12	03845	13214	5	86786	
29	20 8	39 52	82955	7	17045	96180	12	03820	13225	6	86775	
30	6 20 0	5 40 0	9. 82968	7	10. 17032	9. 96205	13	10. 03795	10. 13237	6	9. 86763	
31	19 52	40 8	82982	7	17018	96231	13	03769	13248	6	86752	
32	19 44	40 16	82996	7	17004	96256	14	03744	13260	6	86740	
33	19 36	40 24	83010	8	16990	96281	14	03719	13272	6	86728	
34	19 28	40 32	83023	8	16977	96307	14	03693	13283	7	86717	
35	6 19 20	5 40 40	9. 83037	8	10. 16963	9. 96332	15	10. 03668	10. 13295	7	9. 86705	
36	19 12	40 48	83051	8	16949	96357	15	03643	13306	7	86694	
37	19 4	40 56	83065	8	16935	96383	16	03617	13318	7	86682	
38	18 56	41 4	83078	9	16922	96408	16	03592	13330	7	86670	
39	18 48	41 12	83092	9	16908	96433	16	03567	13341	8	86659	
40	6 18 40	5 41 20	9. 83106	9	10. 16894	9. 96459	17	10. 03541	10. 13353	8	9. 86647	
41	18 32	41 28	83120	9	16880	96484	17	03516	13365	8	86635	
42	18 24	41 36	83133	10	16867	96510	18	03490	13376	8	86624	
43	18 16	41 44	83147	10	16853	96535	18	03465	13388	8	86612	
44	18 8	41 52	83161	10	16839	96560	19	03440	13400	8	86600	
45	6 18 0	5 42 0	9. 83174	10	10. 16826	9. 96586	19	10. 03414	10. 13411	9	9. 86589	
46	17 52	42 8	83188	11	16812	96611	19	03389	13423	9	86577	
47	17 44	42 16	83202	11	16798	96636	20	03364	13435	9	86565	
48	17 36	42 24	83215	11	16785	96662	20	03338	13446	9	86554	
49	17 28	42 32	83229	11	16771	96687	21	03313	13458	9	86542	
50	6 17 20	5 42 40	9. 83242	11	10. 16758	9. 96712	21	10. 03288	10. 13470	10	9. 86530	
51	17 12	42 48	83256	12	16744	96738	22	03262	13482	10	86518	
52	17 4	42 56	83270	12	16730	96763	22	03237	13493	10	86507	
53	16 56	43 4	83283	12	16717	96788	22	03212	13505	10	86495	
54	16 48	43 12	83297	12	16703	96814	23	03186	13517	10	86483	
55	6 16 40	5 43 20	9. 83310	13	10. 16690	9. 96839	23	10. 03161	10. 13528	11	9. 86472	
56	16 32	43 28	83324	13	16676	96864	24	03136	13540	11	86460	
57	16 24	43 36	83338	13	16662	96890	24	03110	13552	11	86448	
58	16 16	43 44	83351	13	16649	96915	25	03085	13564	11	86436	
59	16 8	43 52	83365	14	16635	96940	25	03060	13575	11	86425	
60	16 0	44 0	83378	14	16622	96966	25	03034	13587	12	86413	
M.	Hour P. M.	Hour A. M.	Cosine.	Dif.	Secant.	Cotangent.	Dif.	Tangent.	Cosecant.	Dif.	Sine.	
132°												

SINES, TANGENTS, AND SECANTS.

43°												136°
M.	Hour A. M.	Hour P. M.	Sine.	Diff.	Cosecant.	Tangent.	Diff.	Cotangent.	Secant.	Diff.	Cosine.	M.
0	6 16 0	5 44 0	9. 83378	0	10. 16622	9. 96966	0	10. 03034	10. 13587	0	9. 86413	60
1	15 52	44 8	83392	0	16608	96991	0	03009	13599	0	86401	59
2	15 44	44 16	83405	0	16595	97016	1	02984	13611	0	86389	58
3	15 36	44 24	83419	1	16581	97042	1	02958	13623	1	86377	57
4	15 28	44 32	83432	1	16568	97067	2	02933	13634	1	86366	56
5	6 15 20	5 44 40	9. 83446	1	10. 16554	9. 97092	2	10. 02908	10. 13646	1	9. 86354	55
6	15 12	44 48	83459	1	16541	97118	3	02882	13658	1	86342	54
7	15 4	44 56	83473	2	16527	97143	3	02857	13670	1	86330	53
8	14 56	45 4	83486	2	16514	97168	3	02832	13682	2	86318	52
9	14 48	45 12	83500	2	16500	97193	4	02807	13694	2	86306	51
10	6 14 40	5 45 20	9. 83513	2	10. 16487	9. 97219	4	10. 02781	10. 13705	2	9. 86295	50
11	14 32	45 28	83527	2	16473	97244	5	02756	13717	2	86283	49
12	14 24	45 36	83540	3	16460	97269	5	02731	13729	2	86271	48
13	14 16	45 44	83554	3	16446	97295	5	02705	13741	3	86259	47
14	14 8	45 52	83567	3	16433	97320	6	02680	13753	3	86247	46
15	6 14 0	5 46 0	9. 83581	3	10. 16419	9. 97345	6	10. 02655	10. 13765	3	9. 86235	45
16	13 52	46 8	83594	4	16406	97371	7	02629	13777	3	86223	44
17	13 44	46 16	83608	4	16392	97396	7	02604	13789	3	86211	43
18	13 36	46 24	83621	4	16379	97421	8	02579	13800	4	86200	42
19	13 28	46 32	83634	4	16366	97447	8	02553	13812	4	86188	41
20	6 13 20	5 46 40	9. 83648	4	10. 16352	9. 97472	8	10. 02528	10. 13824	4	9. 86176	40
21	13 12	46 48	83661	5	16339	97497	9	02503	13836	4	86164	39
22	13 4	46 56	83674	5	16326	97523	9	02477	13848	4	86152	38
23	12 56	47 4	83688	5	16312	97548	10	02452	13860	5	86140	37
24	12 48	47 12	83701	5	16299	97573	10	02427	13872	5	86128	36
25	6 12 40	5 47 20	9. 83715	6	10. 16285	9. 97598	11	10. 02402	10. 13884	5	9. 86116	35
26	12 32	47 28	83728	6	16272	97624	11	02376	13896	5	86104	34
27	12 24	47 36	83741	6	16259	97649	11	02351	13908	5	86092	33
28	12 16	47 44	83755	6	16245	97674	12	02326	13920	6	86080	32
29	12 8	47 52	83768	6	16232	97700	12	02300	13932	6	86068	31
30	6 12 0	5 48 0	9. 83781	7	10. 16219	9. 97725	13	10. 02275	10. 13944	6	9. 86056	30
31	11 52	48 8	83795	7	16205	97750	13	02250	13956	6	86044	29
32	11 44	48 16	83808	7	16192	97776	13	02224	13968	6	86032	28
33	11 36	48 24	83821	7	16179	97801	14	02199	13980	7	86020	27
34	11 28	48 32	83834	8	16166	97826	14	02174	13992	7	86008	26
35	6 11 20	5 48 40	9. 83848	8	10. 16152	9. 97851	15	10. 02149	10. 14004	7	9. 85996	25
36	11 12	48 48	83861	8	16139	97877	15	02123	14016	7	85984	24
37	11 4	48 56	83874	8	16126	97902	16	02098	14028	7	85972	23
38	10 56	49 4	83887	8	16113	97927	16	02073	14040	8	85960	22
39	10 48	49 12	83901	9	16099	97953	16	02047	14052	8	85948	21
40	6 10 40	5 49 20	9. 83914	9	10. 16086	9. 97978	17	10. 02022	10. 14064	8	9. 85936	20
41	10 32	49 28	83927	9	16073	98003	17	01997	14076	8	85924	19
42	10 24	49 36	83940	9	16060	98029	18	01971	14088	8	85912	18
43	10 16	49 44	83954	10	16046	98054	18	01946	14100	9	85900	17
44	10 8	49 52	83967	10	16033	98079	19	01921	14112	9	85888	16
45	6 10 0	5 50 0	9. 83980	10	10. 16020	9. 98104	19	10. 01896	10. 14124	9	9. 85876	15
46	9 52	50 8	83993	10	16007	98130	19	01870	14136	9	85864	14
47	9 44	50 16	84006	10	15994	98155	20	01845	14149	9	85851	13
48	9 36	50 24	84020	11	15980	98180	20	01820	14161	10	85839	12
49	9 28	50 32	84033	11	15967	98206	21	01794	14173	10	85827	11
50	6 9 20	5 50 40	9. 84046	11	10. 15954	9. 98231	21	10. 01769	10. 14185	10	9. 85815	10
51	9 12	50 48	84059	11	15941	98256	22	01744	14197	10	85803	9
52	9 4	50 56	84072	12	15928	98281	22	01719	14209	10	85791	8
53	8 56	51 4	84086	12	15915	98307	22	01693	14221	11	85779	7
54	8 48	51 12	84098	12	15902	98332	23	01668	14234	11	85766	6
55	6 8 40	5 51 20	9. 84112	12	10. 15888	9. 98357	23	10. 01643	10. 14246	11	9. 85754	5
56	8 32	51 28	84125	12	15875	98383	24	01617	14258	11	85742	4
57	8 24	51 36	84138	13	15862	98408	24	01592	14270	11	85730	3
58	8 16	51 44	84151	13	15849	98433	24	01567	14282	12	85718	2
59	8 8	51 52	84164	13	15836	98458	25	01542	14294	12	85706	1
60	8 0	52 0	84177	13	15823	98484	25	01516	14307	12	85693	0
M.	Hour P. M.	Hour A. M.	Cosine.	Diff.	Secant.	Cotangent.	Diff.	Tangent.	Cosecant.	Diff.	Sine.	M.
133°												46°

SINES, TANGENTS, AND SECANTS.

44°												135°
M.	Hour A. M.	Hour P. M.	Sine.	Diff.	Cosecant.	Tangent.	Diff.	Cotangent.	Secant.	Diff.	Cosine.	M.
0	6 8 0	5 52 0	9. 84177	0	10. 15823	9.98484	0	10. 01516	10. 14307	0	9. 85693	60
1	7 52	52 8	84190	0	15810	98509	0	01491	14319	0	85681	59
2	7 44	52 16	84203	0	15797	98534	1	01466	14331	0	85669	58
3	7 36	52 24	84216	1	15784	98560	1	01440	14343	1	85657	57
4	7 28	52 32	84229	1	15771	98585	2	01415	14355	1	85645	56
5	6 7 20	5 52 40	9. 84242	1	10. 15758	9.98610	2	10. 01390	10. 14368	1	9. 85632	55
6	7 12	52 48	84255	1	15745	98635	3	01365	14380	1	85620	54
7	7 4	52 56	84269	2	15731	98661	3	01339	14392	1	85608	53
8	6 56	53 4	84282	2	15718	98686	3	01314	14404	2	85596	52
9	6 48	53 12	84295	2	15705	98711	4	01289	14417	2	85583	51
10	6 6 40	5 53 20	9. 84308	2	10. 15692	9.98737	4	10. 01263	10. 14429	2	9. 85571	50
11	6 32	53 28	84321	2	15679	98762	5	01238	14441	2	85559	49
12	6 24	53 36	84334	3	15666	98787	5	01213	14453	2	85547	48
13	6 16	53 44	84347	3	15653	98812	5	01188	14466	3	85534	47
14	6 8	53 52	84360	3	15640	98838	6	01162	14478	3	85522	46
15	6 6 0	5 54 0	9. 84373	3	10. 15627	9.98863	6	10. 01137	10. 14490	3	9. 85510	45
16	5 52	54 8	84385	3	15615	98888	7	01112	14503	3	85497	44
17	5 44	54 16	84398	4	15602	98913	7	01087	14515	4	85485	43
18	5 36	54 24	84411	4	15589	98939	8	01061	14527	4	85473	42
19	5 28	54 32	84424	4	15576	98964	8	01036	14540	4	85460	41
20	6 5 20	5 54 40	9. 84437	4	10. 15563	9.98989	8	10. 01011	10. 14552	4	9. 85448	40
21	5 12	54 48	84450	5	15550	99015	9	00985	14564	4	85436	39
22	5 4	54 56	84463	5	15537	99040	9	00960	14577	5	85423	38
23	4 56	55 4	84476	5	15524	99065	10	00935	14589	5	85411	37
24	4 48	55 12	84489	5	15511	99090	10	00910	14601	5	85399	36
25	6 4 40	5 55 20	9. 84502	5	10. 15498	9.99116	11	10. 00884	10. 14614	5	9. 85386	35
26	4 32	55 28	84515	6	15485	99141	11	00859	14626	5	85374	34
27	4 24	55 36	84528	6	15472	99166	11	00834	14639	6	85361	33
28	4 16	55 44	84540	6	15460	99191	12	00809	14651	6	85349	32
29	4 8	55 52	84553	6	15447	99217	12	00783	14663	6	85337	31
30	6 4 0	5 56 0	9. 84566	6	10. 15434	9.99242	13	10. 00758	10. 14676	6	9. 85324	30
31	3 52	56 8	84579	7	15421	99267	13	00733	14688	6	85312	29
32	3 44	56 16	84592	7	15408	99293	13	00707	14701	7	85299	28
33	3 36	56 24	84605	7	15395	99318	14	00682	14713	7	85287	27
34	3 28	56 32	84618	7	15382	99343	14	00657	14726	7	85274	26
35	6 3 20	5 56 40	9. 84630	8	10. 15370	9.99368	15	10. 00632	10. 14738	7	9. 85262	25
36	3 12	56 48	84643	8	15357	99394	15	00606	14750	7	85250	24
37	3 4	56 56	84656	8	15344	99419	16	00581	14763	8	85237	23
38	2 56	57 4	84669	8	15331	99444	16	00556	14775	8	85225	22
39	2 48	57 12	84682	8	15318	99469	16	00531	14788	8	85212	21
40	6 2 40	5 57 20	9. 84694	9	10. 15306	9.99495	17	10. 00505	10. 14800	8	9. 85200	20
41	2 32	57 28	84707	9	15293	99520	17	00480	14813	8	85187	19
42	2 24	57 36	84720	9	15280	99545	18	00455	14825	9	85175	18
43	2 16	57 44	84733	9	15267	99570	18	00430	14838	9	85162	17
44	2 8	57 52	84745	9	15255	99596	19	00404	14850	9	85150	16
45	6 2 0	5 58 0	9. 84758	10	10. 15242	9.99621	19	10. 00379	10. 14863	9	9. 85137	15
46	1 52	58 8	84771	10	15229	99646	19	00354	14875	10	85125	14
47	1 44	58 16	84784	10	15216	99672	20	00328	14888	10	85112	13
48	1 36	58 24	84796	10	15204	99697	20	00303	14900	10	85100	12
49	1 28	58 32	84809	11	15191	99722	21	00278	14913	10	85087	11
50	6 1 20	5 58 40	9. 84822	11	10. 15178	9.99747	21	10. 00253	10. 14926	10	9. 85074	10
51	1 12	58 48	84835	11	15165	99773	21	00227	14938	11	85062	9
52	1 4	58 56	84847	11	15153	99798	22	00202	14951	11	85049	8
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54	0 48	59 12	84873	12	15127	99848	23	00152	14976	11	85024	6
55	6 0 40	5 59 20	9. 84885	12	10. 15115	9.99874	23	10. 00126	10. 14988	11	9. 85012	5
56	0 32	59 28	84898	12	15102	99899	24	00101	15001	12	84999	4
57	0 24	59 36	84911	12	15089	99924	24	00076	15014	12	84986	3
58	0 16	59 44	84923	12	15077	99949	24	00051	15026	12	84974	2
59	0 8	59 52	84936	13	15064	99975	25	00025	15039	12	84961	1
60	0 0	6 0 0	84949	13	15051	10.00000	25	00000	15051	12	84949	0
M.	Hour P. M.	Hour A. M.	Cosine.	Diff.	Secant.	Cotangent.	Diff.	Tangent.	Cosecant.	Diff.	Sine.	M
134°												45°

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